AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

DECEMBER 1935

VOL 16 NO 12

AGRICULTURAL ENGINEERING

Published by the AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

VOLUME 16 | DECEMBER 1935 | NUMBER 12

CONTENTS

Published monthly by the American Society of Agricultural Engineers. Publication office at Benton Harbor, Michigan. Editorial and advertising departments at the headquarters of the Society, St. Joseph, Michigan . . . . Price $3.00 a year, 30 cents a copy; to members $2.00 a year, 20 cent a copy. Postage to countries to which second-class rates do not apply, $1.00 additional . . . . The Society is not responsible for statements and opinions contained in papers published in this journal; they represent the views of the individuals to whom they are credited and are not binding on the Society as a whole . . . . Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921 . . . .

AGRICULTURAL ENGINEERING

VOL 16, NO 12 EDITORIALS DECEMBER 1935

Engineered Programs for Engineers

FOR THE FIRST TIME in the history of the American Society of Agricultural Engineers some of the technical division sessions at the meetings just held in Chicago were provided with stoplights to enforce the time schedule set up in the printed programs for the various papers. To be sure, the lights and the limits were not at all harshly applied, but it was a noble beginning. Theoretically, at least, the sessions were short, with abundant time for spontaneous discussion. Such discussion should be a major purpose of technical meetings.

When our Society was young, without its own journal for publication of technical papers, it no doubt was necessary for meeting addresses to be prepared in great detail and read in toto. In recent years it has become increasingly the custom for a minority of the speakers (especially when they found themselves near the latter end of a tedious session) to toss their manuscripts on the table and present informally a shortened version, making full use of charts, slides, or movies. This is quite feasible for seasoned veterans of the lecture room.

The Society and its publications have now evolved to a point where it seems proper to propose that meeting papers be prepared in dual form. The longer paper should be designed for publication. It should embody all data that may be useful for intensive study and reference purposes. It may bristle with tables, charts, curves, minutiae of procedure, and bibliographic references. Its illustrations should be in form adapted to engraving and printing. Yet it should, withal, take heed of the limitations of space and patience.

Valuable as is this type of published paper, it overtaxes the capacity of the human mind to grasp, let alone retain, detail. Besides its waste of precious time its soporific influence defeats its own purpose when presented orally in meeting. The paper actually presented should be quite different. The verbal version should set up the problem and procedure in bold outline. It should create a concept as quickly and vividly as possible without bothering too much with refinements and corrections. Its objective should be to get the question before the house for discussion. It should therefore bring out the controversial elements in order to provoke comment and arouse that interplay of minds, that marshalling of experience and judgment which transform a mere audience into a committee of the whole.

The division meetings just closed did not maintain, much less enlarge, the effective use of movies begun in some other recent years. Movies are utterly unsuited for adaptation to publication, but they stand alone in the speed and effectiveness with which they can be made to put over the message of equipment, procedure, and general results. Accompanied by suitable oral explanation they double efficiency by the synchronous use of sight and sound—two senses working where one worked before. Whenever feasible, movies may well be made the backbone of the oral paper.

Another expedient which has proved its usefulness is the distribution of charts, mimeographed copies of the paper, or other "take-away" material. In judiciously chosen cases such presentation is better than blackboards or large charts which are clearly visible to only part of the audience. It has the advantage of being available for marginal notes and for later reference, with accompanying memory value.

Some years ago there was a quip in pedagogical circles to the effect that all of the curriculum was being taught scientifically except the sciences. Let it not be said that engineers fail to engineer their own meetings.

For Lower Wiring Costs

LOW-COST farm wiring, discussed last month in one of the articles in these pages and the theme of an important paper at the ASAE Rural Electric Division meeting just concluded at Chicago, is a subject on which we long have had too much silence. Without calling into question the motives of electrical code authors, the ultimate effect of their efforts has been largely to fortify costs rather than reduce them. In the urban scene this has been no great handicap. On the farm it is a real obstacle. In simple selfishness the makers of wiring materials and electrical contractors should join in the program of cost reduction.

In the discussion following the meeting paper above mentioned, a speaker unknown to this writer but with all the earmarks of experience and responsibility referred to the use of conduit in farm wiring as nothing but a racket. He cited experience indicating that newer forms of wiring with non-conductive sheathing were not only cheaper, but actually superior in a variety of ways. If this be so, there is neither rhyme nor reason in permitting a code created for other conditions to retard rural electrification.

Human safety is just as precious on the farm as inside the city limits. Fire, once started, is even more of a consuming demon. The route to low-cost wiring must not sacrifice safety features which are truly essential under farm conditions. On this score we suggest no compromise.

Yet the distances among buildings about a farmstead, their number and their size mean that the completeness with which they can be equipped for electrical service must be largely an inverse function of wiring cost. Again we face the paradox that—at least in the long run—the job which costs the least costs the most.

The effects on energy consumption and equipment sales are sufficient to make the suppliers of these items highly interested parties to the problem. It is possible that we have placed too much emphasis on their own prices as affecting the adoption and consumption of electricity. Certainly installation cost has been a major deterrent in the electrification program. New policies in line building and connection charges are helping to meet the difficulty. Substantial reduction in wiring costs will complete the attack on the initial-investment obstacle.

What Is the Agricultural Engineer's Job?

An editorial by Harold E. Pinches[1]

A REREADING of the address of President L. F. Livingston delivered at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Ithaca, New York, in October, and published in AGRICULTURAL ENGINEERING for November, brings back the thrill with which it was heard when delivered. The spirit of Mr. Livingston's speech and the opportunity and responsibility of the agricultural engineer are set forth in part in the following words:

> "Industries rise and in their wake others decline and perish, but it is almost a law that the new is greater than the old. Horse-drawn vehicles nowadays represent only a trivial fraction in the industry of transportation, but motor cars have become so common that even beggars may ride. There is in the making a new and a radically altered agricultural industry, the birth throes of which may be painful for the time, but which should not be mistaken for other than what they are. By every precedent this new industry should, in scope and importance, far exceed the old. It will be definitely allied with manufacturing, and the scientist and the engineer will be the chief lieutenants of both. . . . . . . This new agriculture may be something vastly different from the agriculture we have known. The crops of today may not be those of tomorrow. . . . . . . We are only beginning to learn about proper diet; what is now a common weed may be tomorrow's wheat crop; initial phases of the processing of certain raw materials that go into manufacturing may be transferred to the farm and further mechanize it beyond present dreams. But whatever the nature of the new farming, all the signs point conclusively to the augmented importance and influence of the agricultural engineer. More than ever he will be the emissary carrying change from factory and laboratory to the managers and workers of the land."

Such words are thrilling words. They induce us to take a long look into the future. From this vision of the future we come back to assess the activity of the present and the progress of the past. Out of an attempt to so evaluate my own activities and to lay a course for the future, I have come upon a few thoughts which may be of some general interest.

Arising as it did out of farm mechanics (rather elementary shop work, farm carpentry, harness repair, etc.), agricultural engineering has come a long way on the road toward being a real profession and an influential factor in agriculture. Even a superficial acquaintance with the present varied activities of the members of the American Society of Agricultural Engineers would show that the men now engaged in the field are doing a great many things not dreamed of thirty years ago. It is likely that thirty years hence we shall be doing many things still not apparent.

Looking forward with the purpose of taking the leadership that we should in the new agriculture which is arising, some pertinent questions may be asked. One such question is this: Has not too much time and effort been spent trying to adapt new things to traditional farming? Consider the great amount of work that has been done in trying to adapt the tractor to the type of agriculture that grew up under horse husbandry. Comparatively, how little has been done to discover *an agriculture that fits the tractor!* This is hardly typical of engineering at its best. It seems to me that the field of any type of engineering is to discover the real and fundamental problems in any field of human endeavor and then set out with a broad vision to discover a solution which will best conserve values, both material and social.

Another question: What is the fundamental job of the agricultural engineer? This in turn raises a third question: What is the primary agricultural problem of this nation or of any nation? It is not a land policy problem, not a prob- of urban-rural balance in social, economic, and political relations, but is that of supplying annually so many millions of tons of carbohydrates and cellulose. From time immemorial this has been the primary concern of nearly all the people of every nation. It is only recently in human history that men have had any considerable release from the agricultural problem for time and wealth to spend on other aspects of civilization. This release has come through greater efficiency in agriculture.

The history of agriculture shows many forms of economic and social organization, many types of control over land and labor. But the way of doing the work of gaining food, clothing, and shelter was always essentially the same. It involved the full efforts of all but a small group in every nation, as it does among primitive peoples today. So universal was the task and so small the margin between normal returns and insufficient returns that the fear of famine was always present.

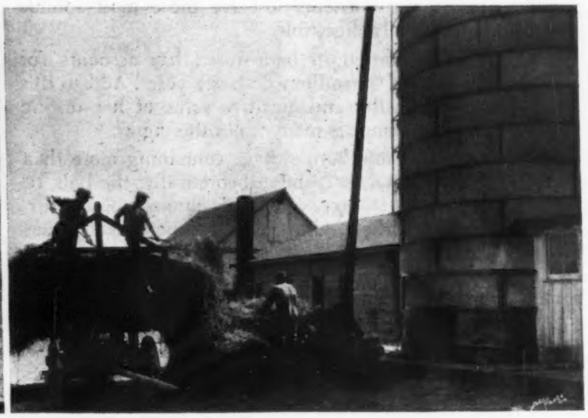
But new ideas are abroad today. The most significant are the control of materials through chemistry and biology, and the control of methods through control of energy relationships. The latter (and to some degree the former) is made possible and symbolized by the tractor—or, more generally, the automotive engine. The thing that has come is more than an internal-combustion engine on wheels. It is mobile power in large units under the control of one man, calculable power, always available, responsive, and untiring.

To go back to my questions: What then is the job of the agricultural engineer? If one goes back to the earlier issues of AGRICULTURAL ENGINEERING, he is almost amused at the number of speeches and papers through which the members of the Society assured each other that there was or could be professional agricultural engineering. The growth of the Society and the great variety of activities engaged in by its members makes such reassurance unnecessary now. But there stands the question whether, among the great variety of jobs, the primary task is being neglected. Is it not true that the real work of the agricultural engineer is or should be the *management of agriculture,* the coordinating of the new techniques of energy control and the new industrial uses with the old outlets for agricultural products.

There may be two rather divergent views of what constitutes agricultural engineering, two rather contradictory activities and two types of persons needed. Both are necessary and both should find a place in the Society. One type of activity is that of becoming expert in one division—possibly even in one part of one division of the work. The type of person needed here may be called the technician. The other type of activity is that coordinating and planning which was mentioned above. This latter activity is the primary task of the agricultural *engineer*.

I do not mean by the distinction just raised between technician and engineer to make any invidious comparison. Both functions may be found even in the activities of one man. The solution of the larger problems will require the best of technical information. Certainly the more completely assembled and accessible the technical information pertaining to our broad field is made, and the more critically it is examined by those qualified to (Continued on page 489)

[1]Assistant professor of agricultural engineering, Connecticut State College. Mem. ASAE.



(LEFT) CHOPPING AND STORING DRY ALFALFA HAY. (RIGHT) ENSILING GREEN ALFALFA

The Handling, Processing and Storing of Legume Crops for Feed[1]

By Howard E. Richardson[2]

INCREASINGLY rapid progress is being made each year in perfecting methods which lessen costs, wastes, and hazards in feed-crop preservation.

The cost of handling alfalfa up to the point of storage depends largely upon the amount of moisture removed and upon the amount of time and the methods employed to do it. It has been determined that the field expense saved through storing alfalfa without any curing is offset by the added expense of loading and hauling moisture-laden hay. Likewise, partially cured alfalfa requires less expensive field handling than either uncured or thoroughly cured hay.

Ohio studies indicate that hay can be put into storage by the chopper method for 73 cents less per ton than mowing away whole hay. An investigation conducted on 100 farms located in 22 states showed an average advantage of only 2 cents per ton for the chopper method, but indicated that rate of harvest is accelerated about 30 per cent with a consequent saving of one man hour per ton. On the basis of these and other studies it seems safe to assume that chopped alfalfa, regardless of moisture content, can be placed in storage at no more cost than storing whole hay.

Chopped hay is obviously much easier to remove from storage than bulk hay. Studies indicate that chopping saves from one-third to one-half the usual time for feeding. When stored in chopped form, different hay crops can be mixed as fed out to avoid the production slump which often follows an abrupt change in quality of roughage. Chopped hay is easy to apportion accurately from a feed cart and can be fed conveniently along with silage or grain.

At least 400 cubic feet of storage space must be provided for a ton of whole hay. Only 100 to 200 cubic feet need be provided for a ton of chopped hay, depending upon the kind of hay, moisture content, and depth in storage. This suggests a large potential saving in the storage structure costs and maintenance.

At the present time there are in use three types of structures for alfalfa storage—the ordinary barn, the ventilated silo, and the tight silo. The latter is obviously the least expensive to build and maintain, excepting the temporary containers made of snow fencing or similar materials which should not be left altogether out of consideration.

It is likewise obvious that providing for hay storage in a silo-like structure adjacent to a one-story, fireproof stock stable is essentially a far safer arrangement than a two-story barn. Liability to wind damage or fire from lightning, careless smoking, overturned lanterns, or engine sparks, is without question materially reduced.

In considering the seriousness of leaf losses in harvesting alfalfa we should bear in mind that about half the plant's total weight is in the leaves. Eighty per cent of the plant's crude protein is in the leaves. With careful handling and most favorable conditions, 15 per cent of the leaves are left in the field. Under less favorable conditions, 60 per cent of the leaves may be wasted.

If the farmer loses one-third of the leaves in harvesting, as many undoubtedly do, he has lost 229 pounds of digestible protein per acre. To replace that loss with linseed meal purchased at $40 a ton, it would cost him $12.40. His loss in digestible fat, fiber and nitrogen-free extract amounts to several dollars more. One investigator estimates that for every 10 acres of alfalfa harvested there is lost $150 to $200 worth of digestible nutrients, the only compensating factor being a 36 per cent return of nitrogen from the shattered leaves to the soil. This estimate is based on leaf losses only.

Further field losses are occasioned by leaching, bleaching, and molding as a result of bad weather. The extent of damage caused by rain is in direct relation to the dryness of the crop. With meadow hay, which is not subject to leaf shattering, as much as 18 per cent of the dry matter can be lost in the field. The actual damage is far

[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers held at Ithaca, N. Y., October 7 to 9, 1935.

[2]Research engineer, Papec Machine Company.

greater because the nutrients lost are those most soluble and hence most easily digestible.

Spontaneous ignition in barn-stored hay accounts for a fire loss of around 30 million dollars a year. Add to this the losses in dry matter and nutritive value of hay during storage, and the amount is many times this figure.

If no hay went into barn storage containing more than 15 or 20 per cent moisture, then, theoretically, the bulk of these losses during storage would be eliminated. Unfortunately, however, the savings thus accomplished would be more than offset by the loss of leaves, color, vitamins, and minerals during the field process of reducing moisture content from the original 75 per cent to 15 or 20 per cent.

Attempts have been made to reduce both field and storage losses by completing the curing process after the crop has been taken from the field. Artificial dehydration is effective but at present too expensive for any but the largest operators. Ventilated storage of partially-cured hay holds considerable promise for future development but may be eliminated from this discussion for the same reason. That leaves tight silos for detailed consideration.

To preserve the fresh fodder in its natural state, led to the investigations in Helsinki, Finland, by Professor A. I. Virtanen, director of the research laboratories of Valio, which is a cooperative butter export association. These investigations led to a method which, according to Professor Virtanen, "is founded on the principles that detrimental decomposition processes in the fodder, above all the respiration of the plant-cells, the breakdown of proteins, and harmful fermentations, such as those caused by coli-bacteria and butyric acid bacilli, are prevented by an addition to the fodder, at the time of ensiling, of the requisite amount of acid which will raise the acidity of the mass to a point between pH3 and pH4 . . . . . Our experiments had proved that at this degree of acidity there is still a surplus of bases in the fodder, and we were therefore justified in expecting that the fodder will be wholesome and that there is no danger of disturbances in the mineral metabolism of animals. Only if acid is added in such quantities that the pH of the fodder sinks below 3, the alkaline reserve is exhausted and the fodder becomes unwholesome."

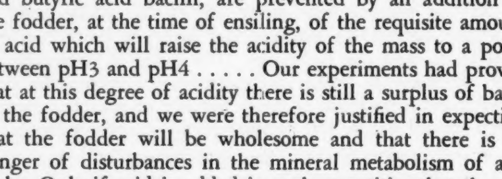
This process since 1929 has been known as the AIV method, after the initials of the originator. It is essentially a method of preserving green plant tissue in almost its natural state by the addition of an acid mixture, namely 2N hydrochloric and sulphuric acids until the pH ranges between 3 and 4. It has become quite successful in Finland due to its usefulness in preserving fodder in a damp climate, where it is difficult to sun-cure hay crops of any kind and especially legumes. It has been used experimentally in a number of European countries and in the United States. The process is reported to give a high feed value to the silage.

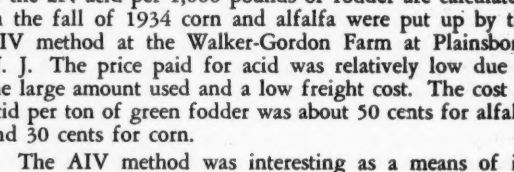
The process consists of cutting the alfalfa, corn, or whatever plant is to be ensiled, in the usual manner for the silo. While being packed firmly in the silo, it is sprayed evenly with the 2N acid mixture, applying a prescribed amount per ton of green tissue. When filled the top of the silo is sprayed with a dilute mustard oil and covered with paper and moistened wood shavings, on top of which is placed a layer of corn silage or dirt to exclude the air.

Highly ionized mineral acids are used as a matter of economy. A mixture of hydrochloric and sulphuric acid has been found to be most satisfactory for this purpose. The quantity of acid required varies with the species of the crop, and to a certain extent with the reaction of the soil and the state of maturity, and must be determined for each crop.

The method of determining the acid requirement is quite simple. Three 200-gram samples of the freshly chopped fodder to be assayed are placed in one-liter beakers. Six, twelve, and eighteen cubic centimeters of 2N hydrochloric acid, respectively, are added to the three samples, together with sufficient water to just cover the mass. A suitable weight is applied to press the material under the surface of the acid. The following day the pH determinations are made of respective samples and the results plotted against the cubic centimeters of acids used. Indicator papers are used for making the pH determinations. From the data obtained in these determinations, the gallons of the 2N acid per 1,000 pounds of fodder are calculated. In the fall of 1934 corn and alfalfa were put up by the AIV method at the Walker-Gordon Farm at Plainsboro, N. J. The price paid for acid was relatively low due to the large amount used and a low freight cost. The cost of acid per ton of green fodder was about 50 cents for alfalfa and 30 cents for corn.

The AIV method was interesting as a means of increasing the color and Vitamin A content of the milk and as an economical way of handling forage crops. The tests on the silage for carotene, which is provitamin A, showed that there is no detectable loss of carotene in the AIV alfalfa. On the dry basis the AIV alfalfa had essentially the same carotene content as fresh alfalfa or machine-dried alfalfa. Likewise, there was no noticeable loss of carotene in converting corn into AIV silage. However, the AIV corn silage put up in this way was no better than the corn silage put up in the regular manner. Complete feed analyses on the regular corn silage and the AIV corn silage did not show any great difference between the two, which sug-





(LEFT) END SECTION OF A SMALL DAIRY BARN DESIGNED FOR CHOPPED DRY HAY STORAGE, IN USE IN IDAHO. (RIGHT) END SECTION OF TWO SHEEP BARNS DESIGNED FOR CHOPPED DRY HAY, IN USE ON A CALIFORNIA RANCH

gests that the acid treatment had not accomplished any significant saving in nutrients. Analyses of the AIV alfalfa silage indicated that the various nutrient constituents had been preserved.

The AIV corn silage evidently underwent some fermentation, as when the silo was opened the end of October, the silage came out warm. This was rather unexpected as the pH was evidently below 4, the point at which the fermentation is supposed to be stopped. The AIV alfalfa did not heat and came out a dark green color. It had a sour but not unpleasant odor.

Photo by courtesy of Commercial Molasses Corporation

A CLOSEUP VIEW OF THE ARRANGEMENT FOR MIXING MOLASSES WITH GREEN ALFALFA SILAGE

In general the results did not indicate any particular advantage in using the AIV method with crops like corn which make good silage when put up in the usual way. With legume crops such as alfalfa the method seems to be very satisfactory. The nutrients are apparently as well preserved as when these crops are machine dried.

Another method of preserving legumes, on which considerable work has been done here and in South Africa, is known as the "low-temperature process," or, more simply, as the "molasses-silage process."

Briefly, this process involves adding about 50 pounds of molasses, diluted to convenient working consistency, to each ton of alfalfa as ensiled. Exact proportions are apparently not essential. When the silo is full, the silage is covered on top with straw and clay and is ready to feed in three to six weeks.

Tests have been made with tower, pit, and stack silage varying in moisture content from that of freshly cut forage to that of semi-cured hay. Results are reported uniformly good. Losses in protein during storage (no data available on length of storage) did not exceed one per cent. In numerous cases carbohydrate content ran higher than that of the original crop, presumably due to presence of excess molasses carbohydrates not converted into acids. Normally some reduction in carbohydrate content would be expected as a result of fermentation.

It is believed that a lactic acid type of fermentation does not reduce digestibility. Lactic acid can be fed to stock in fairly large amounts without special neutralizing agents. In this respect the low-temperature process would seem superior to the AIV process involving free mineral acids. Lactic acid is further supposed on decomposition to furnish the animal with its full combustion value and may even perform the function of a carbohydrate in fat production. Finally, lactic acid seems to play some part in increasing calcium, nitrogen, and phosphorus retention.

Well-liked feeds are unquestionably better digested and are consequently better producers than less palatable feeds of equal nutrients. Reports indicate that cattle may be fed 70 to 90 pounds of molasses-process silage per day without any waste of digestible nutrients whatever. Larger rations have been reported to have been fed with good results.

Work to date on the storing of legumes would suggest the following:

1 Alfalfa regardless of moisture content can be chopped and stored at no more cost than handling the crop in bulk form.

2 Chopped alfalfa is more convenient and less expensive to feed out.

3 A ton of chopped alfalfa dry matter requires one-third to one-half the space necessary for a ton of whole hay dry matter.

4 The type of storage structure adapted to chopped hay is essentially safer than that required for bulk hay.

5 Serious leaf shattering can be eliminated by handling the crop in uncured form.

6 Of all experimental attempts to reduce loss of nutrients during storage, the low-temperature process offers the most promise of meeting the immediate needs of the average farmer.

7 For safe storage in ordinary mows, chopped hay should be cured fully as well as for whole hay storage. Twenty-five per cent average moisture content seems to be about the limit.

8 Twenty-five per cent hay seems to keep better in a mow or in a ventilated silo than in a tight silo.

9 Legumes containing more than 25 per cent moisture require treatment by mineral acids or high available carbohydrate materials such as molasses.

10 Fifty pounds of molasses per ton of unwilted legumes is apparently satisfactory.

11 Wilted or semicured legumes should probably receive additional water or molasses, or both, as ensiled.

There remains for our consideration the field of dehydration. Various types of dryers have been developed. The rotary drum, conveyor type, multiple fan, tray drier, tower dryer, and stack dryer are among the most commonly tried. Various dryers have been built and are in operation in all sections of this country and of Europe.

There is an increasing demand for artificially cured hay and meal. The hay appears to have several advantages over field-cured hay. The vitamin A content is higher since it has not been exposed to sun and light to cause bleaching. It can be produced rapidly and it can be controlled with much less regard for weather conditions.

The disadvantages lie principally in the following:

1 Initial cost of the machinery

2 Fuel costs and man power

3 Size of the installation

4 Lack of portability necessitates increased hauling

5 Machine inefficiency in heat loss, power consumption and production capacity.

Improvements, however, are constantly being effected and may make dehydration of foremost importance in hay processing.

Cooling Milk with Ice[1]

By John E. Nicholas[2]

THE NECESSITY of prompt and effective cooling of the milk as soon as it is drawn from the cow and the need of efficient equipment to do this, especially on farms where mechanical refrigeration is not available, have resulted in the development of coolers designed for use with ice and water. The two types tested and reported in this paper are the wet and the dry.

In the wet type the ice is placed in the cooling water in which the milk cans are immersed. In the dry type (Fig. 1) the tank has a removable central compartment which forms two dry ice compartments on each side of it. The ice rests on sloping grids which keep it against the walls of the central water container. The milk cans are immersed in the cold water of this central container. Table 1 gives the specifications of the two experimental units.

TABLE 1. TANK SPECIFICATIONS

Type	Capacity, 10-gal cans	Insulation: Kind	Insulation: In sides and bottom	Insulation: In top	Outside dimensions, in: Length	Outside dimensions, in: Width	Outside dimensions, in: Height	Sq ft of outside surface
Dry	4	zero	3″	2″	62	36	32½	75.3
Wet	6	zero	3″	2″	57½	41½	32½	77.7

The interior walls of the dry box are made of 22-gauge and the exterior walls of 26-gauge galvanized metal. In the wet type tank both the exterior and interior walls are 22-gauge. Each ice compartment, which is 12 inches wide, will accommodate 200 pounds, giving a total capacity of 400 pounds at one icing. The dry tank is provided with a drain to take care of the melting ice which otherwise would fill the space, float the ice, and nullify the function of the dry ice compartment. In the wet tank an overflow pipe is used which maintains a constant water level by draining off the amount of water equivalent to the ice placed in.

Theory of Milk Cooling. The direct immersion of the milk cans in cold water is the most preferable method, because it offers a large available refrigerating capacity which is obtained from ice or mechanical refrigeration and stored in the water. The rapidity[3] with which the milk can be cooled by this method depends on the type of system, the water-to-milk ratio, the agitation, and the initial temperature of the cooling medium. The dry type tank in this respect is analogous to mechanical refrigeration without agitation. It has been established[4] that a large temperature gradient in the vertical plane may exist in the milk when direct immersion is employed. Such a temperature difference in the milk during the cooling process is not desirable and can be minimized by the agitation of the cooling water[5]. When ice is used as a source of refrigeration in the wet type system, there is a minimum gradient[3] because the refrigeration is supplied from the floating ice; consequently the cooling water is practically uniform as long as ice is available. Equivalent results are obtainable with mechanical refrigeration when the cooling medium is agitated during the cooling process.

A statement that a certain quantity of ice is required to cool a ten-gallon can of milk, without regard to the many factors which greatly influence the overall operating cost, is not complete. The economy of operation depends on the shape of the tank, the amount of insulation used, the milk house temperature, and the useful load. To cool 10 gallons of milk from 95 to 50 degrees Fahrenheit under an ideal condition requires the removal of 3600 Btu (British thermal units), and, theoretically, 23 pounds of ice would provide sufficient refrigeration. However, this amount would not take care of heat losses and the cooling of the milk container; therefore, in actual practice the containers and the heat leakages are very important items in economy of operation[4].

Experimental Procedure. The two milk-cooling tanks were set up, side by side, in the agricultural engineering research laboratory at Pennsylvania State College, where the room temperature varied but 6 degrees (75-81) during the experimental period—June 26 to August 12, 1935.

Temperature gradient in the 10-gallon milk can during the cooling process was determined by 10 thermocouples made with No. 30 copper-constantan wire. These were mounted on a thin rod and spaced 2 inches apart. The rod was placed in the milk can in a vertical and central position so that couple No. 1 was ¼ inch below the milk level and couple No. 10 was 1 inch from the can bottom. A student type of potentiometer with a separate galvanometer to magnify the beam deflections was used. Room and cooling water temperatures were measured with standard mercury-gas-filled thermometers. Artificial ice in 50-pound cake sizes, permitting easy handling, supplied the refrigeration.

The series of tests included the cooling of 2, 3, and 4 cans at once in both types of tanks. A special series was made with the dry tank converted into a wet type by removing the central water compartment and the sloping grids and repeating tests to study and check temperature gradients in the milk can.

Fig. 4 shows temperature gradient in the milk in the dry type tank. Figs. 2 and 3 show the temperature gradients in the milk when the tank was used as a wet type

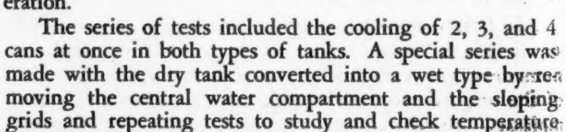


FIG. 1 CROSS-SECTION OF DRY STORAGE MILK COOLER

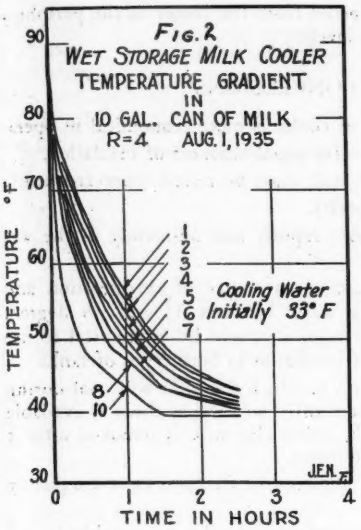
[1]Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers held at Ithaca, N. Y., October 7, 8, and 9, 1935. Authorized for publication on September 30, 1935, as Paper No. 704 in the journal series of the Pennsylvania Agricultural Experiment Station.

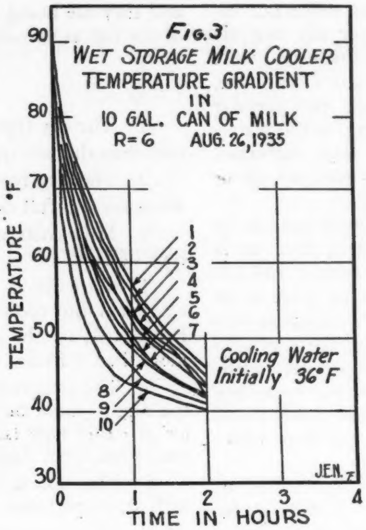
[2]Associate professor of agricultural engineering, Pennsylvania State College. Mem. ASAE.

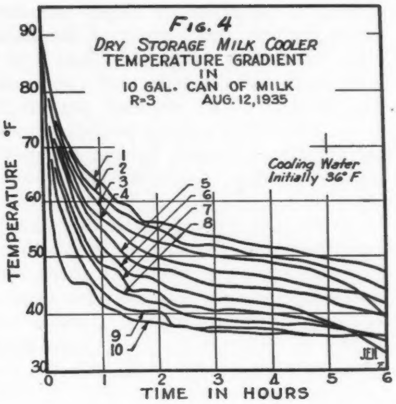
[3]Nicholas, John E., Refrigerating Engineering, Vol. 27, no. 1, pp. 15-18 and 31, January 1934.

[4]The Pennsylvania State College, School of Agriculture and Experiment Station, Bulletin 267, April 1934.

[5]Bressler, Raymond, Jr., and Nicholas, John E., AGRICULTURAL ENGINEERING, vol. 13, no. 9, pp. 230-231, September 1932.







FIGS. 2 AND 3 TEMPERATURE GRADIENTS IN MILK IN WET TYPE TANK. FIG. 4 TEMPERATURE GRADIENTS IN MILK IN DRY TYPE TANK

cooler, in which case there was but 6 degrees difference between the top and bottom of the milk at the end of two hours and all of it well below 50 degrees. In the case of the dry type tank, at the end of the same interval the difference was 19 degrees with approximately 40 per cent of the milk still above 50 degrees, where the water-to-milk ratio is 3 to 1, while the 50-degree temperature was not reached by the entire contents for $4\frac{3}{4}$ hours (Fig. 4). If the ratio is reduced 1 to 1, the temperature is larger and continuous for a greater number of hours[3].

TABLE 2. HEAT LOSSES (DRY TYPE TANK) FROM ICE-MELTING RATE DRIP

Date	Hour	Ice melting rate, grams per hour	Room temperature, degrees
June 26	8-9 a.m.	988	76
June 27	3-4 p.m.	770	75
June 29	9-10 a.m.	871	76.5
July 11	2-3 p.m.	932	81
July 17	7-8 p.m.	721	77
July 18	10-11 a.m.	736	77
July 30	1-2 p.m.	953	77
Average		853	77.1

Preliminary tests were made to establish the water-to-milk ratios and the frequency with which reicing was necessary under particular tests in question. The heat losses were measured during these preliminary tests and checked at intervals in the regular series after the tank had reached constant temperature conditions and weighing the amount of ice consumed for 24-hour intervals. Additional checks on heat losses were determined by weighing the drip from the drain pipe at hourly intervals. Table 2 gives heat losses by the latter method on the dates indicated.

The average heat loss of 853 grams per hour as measured by the ice melting rate drip is equivalent to 45.1 pounds of ice per 24 hours. The average of 10 trials by weighing the amount of ice left at 24-hour intervals was 43.3 pounds. No attempts were made to determine heat losses with the wet type tank.

In a test of the quantity of ice required to cool a 10-gallon can of milk under actual farm operating conditions only the evening milk was cooled. This presupposes that it is usually not necessary to cool the morning milk if it is delivered within two hours after production.

The amount of ice required per 10-gallon can, based on actual farm operating conditions, includes the heat losses and the removal of the heat of the milk and its container. (Table 3.) The evening milk was put in tanks between 4:00 and 5:00 p.m. and removed the next day at 8.00 a.m. All reicing was done between 10:00 and 11:00 a.m., which approximates farm conditions.

Discussion of Results. Tests 1 to 4, inclusive, made with the dry type cooler, show that it required from 38.7 to 40 pounds of ice per can per day. The water-to-milk ratio, so far as ice requirements are concerned, apparently is not an important factor in the economy of operation. It is, however, important so far as rapidity and uniformity of milk cooling is concerned. The average temperature of the milk in the morning was 40 degrees or less, but

TABLE 3. POUNDS OF ICE REQUIRED PER 10-GALLON CAN PER DAY IN THE DRY AND WET TYPE COOLERS, WHEN MILK WAS INITIALLY AT 90 DEGREES F

Test No.	Type of tank	Capacity of tank (10-gal)	Used as	Number of cans cooled: During test	Number of cans cooled: At once	Temperature, degrees (average): Milk initial	Milk final	Cooling water	Room	Pounds of ice per can per day	Days between reicing	Water-to-milk ratio (R)
1	Dry	4	Dry	6	2	90	38.9	36.5	78.0	40.0	4	3.00
2	Dry	4	Dry	8	2	90	36.7	35.8	77.8	43.3	3	3.00
3	Dry	4	Dry	9	3	90	40.0	38.1	79.2	38.7	3	1.67
4	Dry	4	Dry	8	4	90	39.8	36.9	79.9	40.0	2	1.00
5	Dry	4	Wet	8	2	90	36.5	35.9	77.2	50.8	2	6.00
6	Dry	4	Wet	9	3	90	35.5	34.7	77.2	47.5	2	3.67
7	Dry	4	Wet	8	4	90	35.5	34.2	77.0	41.8	1	2.50
8	Dry	4	Wet	10	2	90	37.1	36.2	76.9	54.5	2	6.00
9	Wet	6	Wet	10	3	90	37.8	36.7	77.3	54.6	1	6.30
10	Wet	6	Wet	9	3	90	37.0	36.2	75.5	44.7	1	3.80
11	Wet	6	Wet	12	4	90	38.5	38.0	77.2	40.3	1	2.60

there is a comparatively larger temperature difference between the top and bottom of the milk for the first six hours of cooling (Fig. 4). Tests 5 to 8, inclusive, were made with the dry type tank converted into a wet type. The amount of ice required per 10-gallon can per day varied from 41.8 to 50.8 pounds, increasing as the water-to-milk rato increased, because the useful load decreased, and consequently the heat leakage load is charged up to fewer cans.

In the wet type of cooler the water-to-milk ratio is of importance only because it affects the useful load as is shown in Tests 5 and 8 as compared with Tests 7 and 11. However, this does not affect the temperature gradient in the milk, as shown in Figs. 2 and 3 where the ratio was 4 and 6, respectively. The water-to-milk ratio greatly affects the temperature gradient in the dry type tank. Milk cools more uniformly when ice is placed in the water because the refrigeration is supplied from the floating ice which maintains the water at a uniform temperature without mechanical agitation.

The apparent irregularity of the cooling curves at different levels in the milk can, as indicated in Figs. 2, 3, and 4, is probably due to the chaotic motion of the milk molecules as their kinetic energy is constantly decreasing, and they are being forced from the center to the periphery of the can at various levels.

CONCLUSIONS

1 The dry type of cooler is more economical in operation than the wet type for equal amounts of insulation.

2 The dry type tank must be reiced more frequently when used to full capacity.

3 Milk cools more rapidly and uniformly in the wet type of tank.

4 Since ice is used as a source of refrigeration and maintains the cooling water between 33 and 38 degrees Fahrenheit, on the average, it would be economical to use more than 3 inches of insulation in both types of tanks.

5 The temperature to which the milk will cool during the night cannot be controlled so long as there is available ice in either type tank, unless the milk is removed after it has cooled from 2 to 6 hours.

6 The cooling water must be changed more frequently with wet type tanks.

7 The ice compartments should be scrubbed and rinsed before every reicing.

The Energy Required in the Cooling of Milk

By John E. Nicholas[1]

THE MILK PRODUCER recognizes the importance of cooling the milk as soon as it is produced, and since this involves an investment in the necessary equipment the question of economy of operation becomes of immediate interest.

Refrigerants commonly used in the small, electrically driven units show practically the same horsepower required per ton of refrigeration. The types of tanks in the modern farm milk cooling unit are in general of similar construction and shape and 3 inches of insulation is standard.

It is universally accepted that the quality of all foods is retained, if kept in cool room. More recent research with highly perishable commodities gives conclusive evidence that very definite temperatures are extremely important. Milk which has been aseptically produced and immediately cooled in practically sterile utensils to 45 degrees Fahrenheit and maintained at that temperature will retain its original quality for weeks without any growth of the bacteria initially present.

The lower limit to which milk should be cooled is therefore determined by the temperature at which the milk bacteria fails to multiply. The upper limit is the body temperature of the cow. The quantity of heat that must be removed to cool the milk depends upon these limits of temperature, the amount, and to a slight degree the butter fat content of the milk.

Since the lower limit in the minds of many has not yet been accepted, milk cooling units of 2, 4, and 6-can capacities have been tested, in which the milk was cooled by direct immersion to three different temperatures, 33, 40, and 50 degrees, approximately.

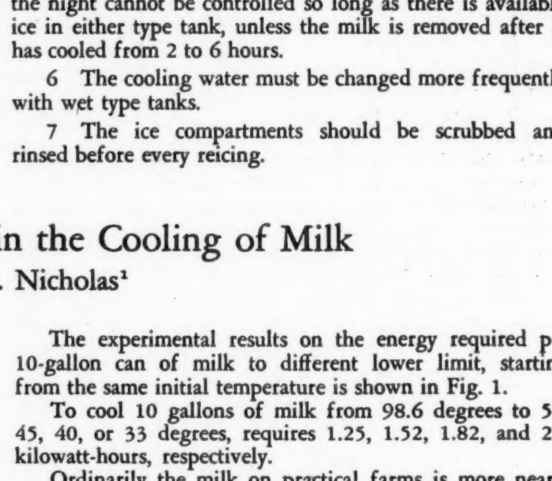
The energy consumption was measured by a rapid watthour test meter. All units had air-cooled condensers. Three different refrigerants were used—sulphur dioxide, methyl chloride, and dichloridiflouromethane.

[1]Associate professor of agricultural engineering, Pennsylvania State College. Mem. ASAE.

The experimental results on the energy required per 10-gallon can of milk to different lower limit, starting from the same initial temperature is shown in Fig. 1.

To cool 10 gallons of milk from 98.6 degrees to 50, 45, 40, or 33 degrees, requires 1.25, 1.52, 1.82, and 2.5 kilowatt-hours, respectively.

Ordinarily the milk on practical farms is more nearly 90 degrees when it is ready for cooling, so that if it is cooled to the preferable temperature of 45 degrees, the energy required will be very nearly 1.5 kilowatt-hours per 10-gallon can. It is necessary to note that 1.5 kilowatt-hours includes all factors.



THIS CURVE SHOWS THE ENERGY REQUIRED TO COOL A 10-GALLON CAN OF MILK FROM 98.6 DEG F TO DESIRED TEMPERATURES

Electric Uses in the Greenhouse[1]

By W. C. Krueger[2]

THE PURPOSE of this paper is mainly to summarize the applications of electric energy to greenhouse production since the wealth of detailed information on the individual applications is such as to make it impossible in the time allotted to cover the subject from the operative standpoint.

This is particularly true of the most common of electric uses—soil heating. During the past thirteen years development in the use of electric heat for hotbeds and cold frames has justified a wide acceptance among vegetable gardeners. Of late nurserymen and florists have applied it to their bench crops as an ideal medium for supplementing greenhouse heat and for controlling growth on restricted areas in the greenhouse. The principal uses are heating soil for the germination of seeds, propagation of cuttings, and forcing of transplants. Nurserymen report getting better results in rooting cuttings in electrically heated beds than in manure or other type beds. It is easier to maintain an optimum temperature and the labor and annual investment costs are greatly reduced. Experience shows that there is a decided advantage in being able to keep the soil from 15 to 20 degrees above air temperature, particularly with evergreen and hardwood cuttings. Quicker callousing is reported and less root rot. Rose growers are turning to electric heat for propagation of cuttings. One New Jersey grower provides replacement for two 70-by-600-foot rose houses with 120 square feet of electrically-heated sand-cutting bed. Florists find electric seedbeds of special value in attaining quicker germination of a high percentage and in controlling bed temperatures independent of the regular greenhouse heating system. Optimum soil temperatures differ with crops, but a generalization might be made that best results are obtained with air temperatures around 55 degrees and with soil temperatures held from 65 to 75 degrees.

A specialized use of soil heating is in bulb forcing. Bulbs, such as lily-of-the-valley, are placed in flats in a bed of moss or sand electrically heated, enclosed in a box so that the humidity may be held at a high constant level, and the temperature regulated to control exact time of flowering.

The use of soil heating for vegetable production in greenhouses is a widely accepted practice in areas where out-of-season vegetables under glass have a profitable market.

Hotbed heating represents a very desirable utility load, the power factor is practically 100 per cent, the load is applied largely at night, and the seasonal demand corresponds with stream flow and surplus power.

The use of lights for plant stimulation represents a relatively new field. In principle, light may be used to speed the growth and flowering of long-day plants during the short-day season or retard the growth or flowering of short-day plants during the short-day season. Retarding the growth of long-day plants during the summer season, and accelerating the growth or fruiting of short-day plants during the long-day season is accomplished by shading. The necessity of supplementing daylight in the growing of long-day plants during the winter season is evident from records for the north central states which show that from November through March we have on the average 37 clear, 33 partly cloudy, and 82 cloudy days. The growth of plants is the result of balance between the amount of nitrogen absorbed and assimilated and the amount of available carbohydrates that the plant manufactures. The assimilation of nitrate depends on the reducase activity which is an enzymatic action stimulated by light, and therefore we have a growth-control measure available in the form of artificial illumination to supplement that deficient under natural conditions. It is essential in the application of light to plant-growth control that plant feeding be correlated as a part of the management system, to prevent excessive vegetative growth, weak stems, or the equally objectionable woody type of growth.

With regard to color, the visible range of the spectrum has been found most effective, with ultraviolet tending to inhibit growth and the infrared tending to produce a weak rangy type of growth. Satisfactory light intensity ranges from 1 to 5 foot-candles necessitating from 4 to 13 watts per square yard of area at 40 inches distance. The optimum time of lighting is not definitely determined, but data indicate the desirability of supplementing daylight on a continuous basis either evening or morning. For economy the largest size lamp giving uniform coverage should be used. A 1000-watt lamp gives two times the lumens per watt of a 40-watt lamp and costs less than one-half the equivalent light value number of 40-watt lamps. Also the installation cost and upkeep are lower. The necessity for good reflectors correctly shaped and spaced to give even diffusion of light is apparent. Lengthening of the lighted period increases the assimilation of nitrates which in many cases will result in increased flower production, and in all cases makes for greater stem growth and places the flowering period more definitely under the control of the grower. It is an application that justifies the serious consideration of every commercial florist and plant grower.

Soil Sterilization. Organic soils used in the greenhouse normally contain animal organisms, fungi, molds, bacteria, and weed seeds—all detrimental to plant growth. It is necessary to pasteurize these soils or treat them with chemicals as a part of the management program. Steam sterilization has the advantage in that it combines weed and pathogen control. Steam equipment is expensive for the small-scale operator, and therefore there is a wide field for the application of electric heat as a pasteurizing medium.

Two methods of application are available. In one—the batch method—the soil is placed in a box, drum, or other container and heated by means of conducted heat from resistance wires. In the other—the resistance method—the soil is heated by reason of electric current passing through it. The batch method involves handling the soil both before and after sterilization and offers an opportunity for reinfection. The resistance method may be applied to soil in place, eliminating further soil handling and possible contamination.

Four methods of applying the resistance method to soil pasteurization are in use. One consists of setting metal strip conductors into the soil bed at suitable intervals, connecting them alternately to the two poles of electric circuit, and applying the current. A variation of this is placing the

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[1]Paper presented at a session of the Rural Electric Division during the 29th annual meeting of the American Society of Agricultural Engineers at Athens, Georgia, June 17 to 20, 1935.

[2]Extension agricultural engineer, Rutgers University. Mem. ASAE.

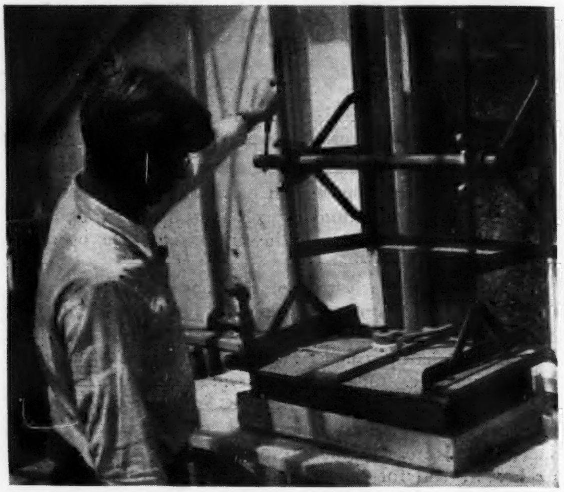
strips in a box, packing soil into it, and after treatment pushing the soil out of the bottom of the box. Another variation is that of placing the soil on a metal conductor plate, pressing the other conductor down on the soil layer, and thus subjecting the soil to current. Since these methods involve either handling individual strips or handling the soil after treatment, a fourth method suggested itself. This is to hold the required number of conductor strips in an insulated plate unit. This is, in turn, held in a frame permitting vertical adjustment. Flats are centered under the unit (see accompanying illustration) which is then forced into the soil and the current turned on automatically by means of a stop or limit switch. To overcome the tendency of strips pulling away from the soil when inserted, the strip is made wedge-shaped in cross section, thus maintaining a positive contact with the soil on either side. A variation of the strip conductors to make the unit applicable for portable use is the substitution of tapered pins. These penetrate the soil with less resistance. The strip assembly method has been on trial at the New Jersey agricultural experiment station for over a year with excellent results.

Ventilation and Humidity Control. Automatic control for the ridge ventilators of greenhouses has recently been perfected. Two distinct systems are in use. The first one is very simple and consists of two main parts. The first is a suitable thermostat for a greenhouse similar to those used for any ordinary heat control. Of course it must be borne in mind that a thermostat to work in a greenhouse must be of the mercury tube type as the contact points on the others are apt to become corroded. The second part of the apparatus consists of a motor with automatic cutout switches built in. It depends on the length of the run of apparatus to be operated what size motor is necessary. Under the control of the thermostat the motor operates the ridge sash to a small amount of opening, usually from three to four inches. When the house reaches the desired temperature, the sash open this small amount, and then as soon as it cools the sash are closed. For summer operation the ordinary hand gear can be used, giving full opening of the sash if desired.

The other type of ventilating control again has the same two parts, a thermostat and motor, but a different type of thermostat and motor are used. Again the sash opening is limited to a small amount as before, but this type of motor, which is known as a modulating motor, together with its thermostat, opens the sash in small increments instead of the full three or four inches. As the temperature goes up the sash will gradually be raised a little at a time. As the temperature falls the sash will gradually be lowered so that you do not have the two positions of just closed and open, but have any intermediate position that may be provided for by the thermostat.

The second type of apparatus is more expensive than the first. With the first type installation is a short run, say, up to 16 feet of sash, and can generally be made for around $100. For the second type of apparatus the same installation would cost at least $200. The cost of longer runs depends entirely upon the length of the run and the corresponding amount of motor power required.

Lily-Scale Propagator. Florists interested in the propagation of rare lilies may remove the scales constituting a high-priced bulb and propagate the scales rather than plant the entire bulb. Thus several dozen plants may be obtained from one bulb even though one loses a year in flowering time. The propagation of these scales requires absolutely uniform temperature under saturated humidity conditions. Electric heating and control are therefore ideal. A lily-scale propagator built last year was made by insulating a small cabinet and placing a 50-watt resistance plate heater at the bottom in contact with a long shallow pan of water. Wire trays for the scales were placed above the pan at 2-inch intervals. A hermetically sealed and calibrated bimetallic thermostat set for 75 degrees on rising temperature gave positive control. The desirable humidity was maintained by water evaporation from the pan. Excellent results were reported for the two periods of operation.



THIS PICTURE SHOWS THE STRIP ASSEMBLY UNIT FOR APPLYING THE RESISTANCE METHOD TO SOIL PASTEURIZATION

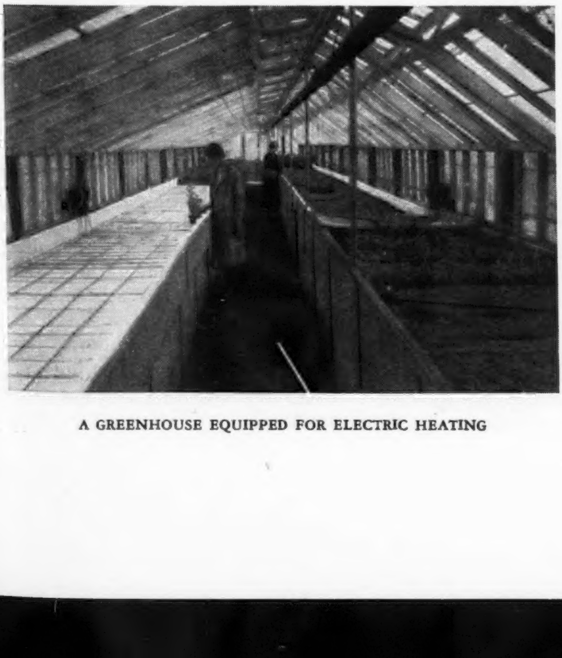
Plant Feeding. The growing of plants in an inert media is a recent development which gives promise of widespread application. Growing plants in sand, cinder ash, slag, or similar material and feeding the plants by applying a nutrient solution to the bed eliminates the cost of preparation of compost soils, the frequent sterilization of soils, and the labor involved in changing soils, and in controlling weeds. Solution feeding also places plant growth under controlled nutrition. The application of the solution has so far presented a problem in labor costs and a control of the human element in time and thoroughness of application.

A possible answer to this problem is offered in a method developed this year for automatically applying nutrients to the sand beds through the use of a motor-operated pump, valves, and pipe. The bed is made watertight with a central sloping trough covered with inverted half tile. This trough is pipe-connected outside the bed to a level chamber which controls the height of the solution in the bed. A lever which may be hand operated, or actuated by means of a clock-controlled cam, starts the motor and simultaneously opens a valve admitting the solution from the level chamber through the pipe to the plant bed. As soon as the bed is flooded the lever shuts off the motor, closes the valve from the level chamber, and opens a drain valve, thus permitting the excess solution to drain from the bed through the same pipe system used for feeding. Any number of beds can be handled from one central control unit, the only duplication necessary being the interlocking control levers and feed pipes. Beds requiring different types of solutions may even be handled with the one unit by using shut-off valves in suction lines from the stock solution tanks to the motor. Feeding the beds from below avoids all possibility of wetting foliage and thus encourage leaf fungi, and it avoids possible mechanical damage to plants. It also provides positive aeration of the bed by reason of air displacement

at feeding and thorough aeration at drainage, and it assures absolute penetration of the solution to all parts of the bed and prevents adverse accumulation of chemical residues. Feeding requires but a minute of the grower's time and even this dependency on the human element may be eliminated by clock cam control of the unit. The electric load in this application is light, but it offers a very practical money and labor-saving application of electricity to greenhouse practice.

Electric Heating. Complete electric heating of greenhouses may be impractical, except for mild climates, but it offers under these conditions a most desirable means for heating the greenhouse. For frost protection purposes electric heating can be recommended under all conditions, and particularly in connection with a standard heating system during late spring and early fall periods. The California agricultural experiment station reports comparison costs for heating on a 20-by-80-foot greenhouse for frost protection with gas and electric heat. The installation cost for electric heat was set at $100 as compared with $600 for the cost of hot water or steam boiler. The cost of electric operation for 5000 kilowatt-hours was $100, and with depreciation and interest of $16.00 giving a total of $116.00. Gas operation for 37,000 cubic feet cost $22.20, and with interest and depreciation of $96.00 giving a total of $118.20. Temperature was maintained between 40 and 41 degrees, this close control being possible only with electric heat. Outside temperatures were given as 32 degrees. The heating system consisted of resistance wires distributed evenly throughout the entire house immediately under the benches. For protection against moisture the No. 12 Monel wire was enclosed in half-inch galvanized pipe. The New York (Cornell) agricultural experiment station reports an experiment on keeping heat and humidity constant in the greenhouse. It was possible to control both and prevent the common and objectionable violent humidity changes. Space heaters with a demand of 6 kilowatts heated the air in the 40-by-6½-foot section. The air temperature was kept at 55 degrees and the humidity constant; under these limitations this apparatus could be used only during the coldest months of the year. In conclusion, the report states that complete and automatic electric control of greenhouse temperature and humidity is not economical at the present time, although it offers an excellent opportunity to maintain ideal conditions for experimental work in rooting cuttings.

We believe that the greatest field for electric use in the greenhouse has not been accorded deserved attention. This is the distribution and conditioning of the air in greenhouses by means of motor-driven fans. With a central unit heater, steam or hot water, and air forced through ducts to suitable outlets in the greenhouses, it should be possible to thermostatically control the temperature in any house, insuring uniform temperatures throughout the house by reason of constant air movement, providing a means for humidity control and for fumigation by injection of fumigants into the air stream. Such a system would also facilitate the dispersal of CO_2 throughout the houses without supplementary equipment. The cost of installation should be much lower than that with steam or hot water distribution, and the cost of moving air can well be within the range of economy.



A GREENHOUSE EQUIPPED FOR ELECTRIC HEATING

That the trend in greenhouse construction and increased used of electric equipment is approaching this ideal is evidenced in a report on the construction of a new type of insulated greenhouse employing incandescent lamps as a source of heat and light recently developed at Boyce Thompson Institute. This greenhouse is constructed of galvanized steel sheets inside and outside leaving a 6-inch space for insulation. The window section consists of ordinary storm sash set in a part of the roof and wall on the south side of the house. An insulated door was used, purposely made small, 2 by 4½ feet, to guard against heat losses when open. Two rows of five mazda lamps each were used as a source of heat and light. Five hundred watt lamps were used during December, January, and part of February, and thereafter 300-watt lamps. Lamps were adjustable as to height and were thermostatically controlled to limit the temperature range between 60 and 100 degrees. Results from this test indicate that a greenhouse 8 by 19 feet can be heated and lighted during the coldest winter months for daily energy consumption of about 18 kilowatt-hours.

In connection with fumigation there is an interesting development awaiting commercialization. Naphthalene fumigation is a desirable though precarious practice in the control of red spider, white fly, mites, and general insects. It is necessary that the air be saturated with naphthalene vapor, yet condensation of the naphthalene on plants must be prevented. To vaporize the napthalene, it is best to dis-

ELECTRIC USES IN THE GREENHOUSE

USE	DEMAND	ENERGY	
Heating greenhouse, 20 by 70 feet	15 kilowatts	37,500 kw-hr per season	Small greenhouse equipment cost ¼ oil—¾c kw-hr equivalent to oil operating cost
Greenhouse—hotbed	100 w per sq yd maximum to 50 w per sq yd	1.45 to 0.5 kw-hr per sq yd per day	Average, 1 kw-hr per sq yd per day —20 deg F differential
Soil sterilization	3 to 7 kw for resistance flat unit 2 to 5 kw for batch ½ to 1-yd unit	20 to 40 kw-hr per cu yd	
Bulb forcing	50 to 75 w	600 w per day	
Light	4 to 13 w per sq yd at 40	Dependent on crop area normal sunlight	
Ventilation and humidity control	200 w to 1,000 w	Small—short time use	
Plant feeder	0.25 to 1 kw	1 w per week per sq ft per bed	

solve it in SAE 20 lubricating oil and then force the air through the oil picking up the naphthalene under saturated conditions and diffusing it throughout the greenhouse. The unit incorporates a motor-driven blower, an oil container, and an air washer to remove the oil. Such a device would have a wide acceptance in meeting the demand for a practical means for naphthalene fumigation.

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A Device for Sampling Hay[1]

By Frank. J. Zink[2]

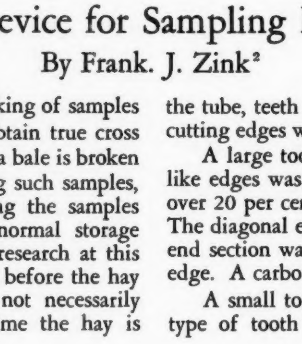
IN ANY STUDY of hay involving the taking of samples for moisture analysis it is difficult to obtain true cross sections. If the hay is forked over, or if a bale is broken into, considerable labor is involved in taking such samples, and the redistribution of the hay in taking the samples changes its characteristics and upsets its normal storage conditions. In conjunction with some hay research at this experiment station, samples had to be taken before the hay was placed in storage. Such samples do not necessarily represent the conditions existing at the time the hay is placed in storage, and also when in storage it was not possible to take samples as desired.

A device for taking samples was designed and has been in use by the author for several seasons. Other investigators have found it useful, and the following description is given with the hope that it may prove of general value. The design was worked out after a search of literature revealed no description of a device for this purpose.

The device is a modified hole saw similar to the round-hole hack saw. It comprises a sampling tube or core saw. The accompanying illustration shows the apparatus. It consists of a thin steel tube about 3 inches in diameter by 18 inches in length. The steel used was similar to that used in a carpenter's saw. In one end was secured a standard carpenter's bit shank with which an ordinary carpenter's bit brace may be used. At the other end of the tube, teeth were filed for a cutting edge. Two styles of cutting edges were found necessary to meet all requirements.

A large tooth 1 inch long by ½ inch deep with knife-like edges was found most suitable for wet hay containing over 20 per cent moisture, or for hay which is in the sweat. The diagonal edges were beveled and sharpened. The tooth-end section was heat-treated for preservation of the cutting edge. A carborundum of whetstone is used for sharpening.

A small tooth has been found better for dry hay. This type of tooth is similar to that of a 6-point carpenter's saw. In this tube the cutting end was not heat-treated. The teeth are sharpened by same means and method as used for sharpening a saw.



APPARATUS FOR SAMPLING HAY. A, KNIFE TOOTH FOR WET HAY. B, SAW-TOOTH FOR DRY HAY. C, ROD FOR EJECTING HAY SAMPLE

Each sampler weighs about 3 pounds. A 10-inch sweep bit brace has been found fairly satisfactory. However, a 14-inch sweep bit brace would serve better, especially for sampling wet hay.

The device operates exactly as in boring a hole with a wood bit. In dry hay the full depth of about 20 inches may be cut without removal of the core. However, the cores are more easily removed if only about a 10-inch cut is made between cleanings. A full-depth cut in baled hay contains a sample of about 400 grams.

The use of these samplers has made it convenient to take samples and cross sections of hay in various types of storages. Samples have been taken from baled hay in less than a minute. Three and 6-foot extension shanks have been used and samples procured to about 8 feet in depth in mow storages. The device has proved a practical means of sampling and has considerably enhanced hay research involving storage.

[1]Contribution No. 68 of Department of Agricultural Engineering, Kansas Agricultural Experiment Station.

[2]Agricultural engineer, Kansas Agricultural Experiment Station. Mem. ASAE.

An Engineering Viewpoint on Farm Fencing as an Investment[1]

By R. C. Miller[2]

A DISCUSSION of the subject of farm fencing as an investment at a meeting of agricultural engineers implies that we want to bring out or clarify the problems in farm fencing as an investment, in so far as the solution is our responsibility.

In the case of the farm fence, as in all farm structures, it is as difficult to prove its value as an investment as it is to prove there is truth in the old saying "They also serve who only sit and wait." It is so easy to see the value of the equipment used in raising a crop, such as a drill or binder, or of the power and labor used to operate the equipment, because there is activity. The transfer of energy can be definitely measured, so the value or cost of the service can easily be evaluated. Activity also attracts attention so that the services are advertised.

The farm fence being passive and stationary has little to draw favorable attention. The farmer is likely to notice the fence oftener when it is a nuisance, or a handicap rather than a help. The hours of labor spent in cutting weeds along a fence on a hot day surely will give an emphatically unpleasant impression of the fence, whereas the services the fence renders, such as preventing the trampling of grain in the adjoining field, is not so readily appreciated.

The citation of figures which show the rods of fencing in use and its cost in dollars is likely to impress us much more as an indication of the magnitude of waste rather than of service. Either impression should attract attention so I will risk a few figures. The fence must be of some service to farmers, or the average farm in the United States would not have between 600 and 700 rods of fencing, nor would the average midwestern farm have 10 rods of fencing per acre, for the 160-acre farm[3]. To use a trite expression, it would be rather presumptuous to assume that six million American farmers were wrong.

There seems to be no evidence to show that the need for fencing has become less important, but there is plenty of evidence everywhere that fences are not being repaired and maintained.

The statement that "The farm fence is an essential structure on a farm as long as livestock is a fundamental part of a progressive farming program," will no doubt be acceptable as a sound premise by all. The situation may be more properly described by the statement that in general six million farmers are wrong in their present farm fence program. If such a program is continued the results of course will be disastrous.

The cost for a woven wire fence in place is about one dollar per rod for a four-foot high fence[4]. About 80 cents of the cost of this fence is for material and 20 cents is for labor. Such first or replacement cost figures are dangerous to keep in mind, because they will likely prevent our seeing the more important figure of annual cost. In our attempt to obtain a low first or investment cost we are likely to obtain a high annual cost, inefficiency in farming, and in some cases perhaps a forced abandonment of livestock farming.

The fence item in the farm budget takes a major place when we realize the amount and cost of fencing. On many farms in Ohio it is my opinion that the cost of the fence is 10 per cent of the value of the farm. A similar figure was given for Indiana by Wm. Aitkenhead of Purdue University to the "Ohio Farmer" in that publication's recent farm fence survey. This cost is due to such well-known and easily recognized factors as high repair costs and short life.

This survey by the "Ohio Farmer" showed estimates of fence life varying from 3 to 40 years. The average was 16½ years. This would give an annual depreciation cost of 6 cents per rod. The repair costs usually are about 50 per cent of the annual depreciation, or 3 cents, making a total annual cost of 9 cents per rod. This is only on one-half of the annual upkeep estimate of 18 cents per rod, given by Professor Aitkenhead as the average for 30 Indiana farms.

One way of reducing the annual fence costs is to increase the life of the fence. This is accomplished about as follows, if the suggestions of the farmers themselves, as given in the previously mentioned "Ohio Farmer" fence survey, have merit. According to this survey the durability of the wire was considered the greatest essential of a good fence by 33 per cent, or almost twice as many farmers as those who considered strength (18.3 per cent) the most essential factor of a good fence. The posts were in third place, or 14.3 per cent of the farmers considered them most essential. The design of the fence, involving such factors as type, joints, kind of weaving, type of spacing of stays, took fifth place with 11.6 per cent.

The one greatest single factor mentioned was galvanized fence, which was considered first by 18.8 per cent of the 1,000 answers received. Strong posts was second as single items, being mentioned as first by 9.6 per cent of the farmers. This was followed in turn by weight of fence, 9.3 per cent.

There are other important factors such as having good corners and ends, the use of barb wire at the top and bottom of woven wire fencing, etc.

Some methods and techniques exist for accomplishing these results in fencing. However, exact information as to their importance does not exist. There should be more scientific information available on wire and fencing than the opinions of users. The tests on wire now being conducted by the American Society of Testing Materials is a big step in the right direction, and deserves our enthusiastic support.

The second great problem demanding proper attention to fencing is to have all these desirable practices accomplished. This is a more difficult problem, in my opinion, than to find out what to do. There are so many demands on the farmers' capital and labor that it is so easy not to provide for fences. The solution of this problem seems to

[1]Paper presented before the Farm Structures Division at the 29th annual meeting of the American Society of Agricultural Engineers, at Athens, Georgia, June 17 to 20, 1935.

[2]Professor of agricultural engineering, Ohio State University. Mem. ASAE.

[3]K. J. T. Ekblaw. Report on galvanized fencing presented at the annual meeting of the American Society of Agricultural Engineers, June 1933.

[4]Information Series No. 28. Fences. Bureau of Agricultural Engineering, U. S. Department of Agriculture.

be one largely of educating the farmer to appreciate the services of fences which make them a good investment. The arguments in the case may not be so much in the line of what the farmer can afford to do, but rather what he can not afford not to do. This double negative is in line with the passive and stationary service of fences. It is possibly not so much a case of whether the farmer can afford to maintain a fence as whether he can afford not to maintain it.

These research and educational activities may be conducted not only among fence users, but also among the manufacturers of fence and fencing materials. It is essential that they know what is needed in their field to make a good fence. Then it is very necessary that they make such fencing. There also should be a way for a farmer to identify the composition and quality of a fence. There should also be a guarantee of quality so that the fence user is sure of the service of the fencing he purchases. That possibly is a final but essential step necessary in assuring adequate fencing. It certainly would at least open the bag enough to show the buyer what kind of cat he is buying. Certainly good fencing material is an essential of good fencing.

It seems to me that there should be definite recommendations from this Society as to the research and educational activities to be conducted for the benefit of better farm fence investments.

Problems in the Production of Farm Fencing[1]

By Walter M. Floto[2]

THE HISTORY of woven wire fence is an interesting one. Briefly, the most effective means of livestock and crop protection in the early days prior to 1877 was barbed wire of various types. Injuries to livestock from barbs were so numerous that attempts were made to legislate against the use of it in many states.

However, on January 30, 1877, a patent was issued to A. C. Decker, a barbed wire manufacturer at Bushnell, Illinois, covering the first fence which was constructed with three strand wires connected with short sharpened stay wires, the points of which were bent outward to form barbs. However, this fabric did not prove successful and its manufacture was soon abandoned. In 1886 William Bell, of Verona, Missouri, was granted a patent on a type of field fencing without barbs, designated as "a combined frame and wire fence which shall possess sufficient strength without barbs to repel stock." Subsequent patents were issued to other individuals on various shapes of meshes, such as keystone, diamond, and square. The last was found to be more economical for consumers, hence its popularity today. Even though the method of fabrication by various manufacturers differs somewhat, resulting in many variations in knots or joints, the so-called "hinge joint" is now recognized as the most popular type.

Steel wire is made in many varieties. Reputable manufacturers use every precaution in the selection of wires entering into the manufacture of woven wire fence, knowing that durability for general farm purposes is contingent upon maximum tensile strength in the horizontal or line wires, these necessarily being harder than the stay or upright wires, which in woven fabrics are subjected to torsion in fabrication. In this connection care must be taken to prevent the zinc coating or galvanizing from cracking.

The remaining factors which determine the quality of woven wire fence are (1) quantity and quality of zinc coating, or galvanizing, (2) gauge and diameter of wires, (3) spacing of stay or upright wires, and (4) holding power of the knot. If these factors exist in full measure, regardless of what the trade name may be, it is a good fence.

Weight is the simplest verification of stay wire spacing or gauge of wires, or both, for the average consumer. This is of great importance, for by utilizing scant gauge wires and spacing the stay or upright wires a very small fraction of an inch beyond the standards, which today are 6 and 12 inches, the unscrupulous manufacturer can effect a large saving in manufacturing costs, which is not passed on to the consumer.

Claims of superiority in galvanizing, or protective coatings, through various processes have been not only numerous but rather wide in scope during the past several years. Much can be said on this subject, as its importance is of rather high standing in woven wire fence manufacture. There are several methods of application, but this is of little consequence, if the highest quality of zinc containing a minimum of impurities is used—also applied uniformly—and of a thickness up to the point where it will not crack or peel after fabrication.

There are two laboratory tests commonly used to measure galvanizing on woven wire fence. The so-called "immersion test" in a standard copper sulphate solution is the best for determining uniformity of application, though it is sometimes used for thickness. The other, known as the "strip test," involves weighing of the galvanized wire, and again after the galvanizing has been removed. However, since the extent of zinc purity is not determined by these tests, and the fact that exposure to the elements does react in favor of the purest zinc, considerable reliance on durability of protective coating is placed on actual service in the field.

Opinions on various constructions of knots vary; likewise do the manufacturers' sales arguments. Consumers should not be misled, as the holding power of a fence knot depends upon tightness of its grip on the line wires and the amount of knot wire that is in contact with the line or horizontal wire of the fence—in other words, frictional resistance. A knot, regardless of its shape, that has two or three wraps in contact with the line wire obviously is superior to one with only one or a part of a wrap in contact.

Design standards were reduced materially in number some few years ago, resulting in a material benefit not only to manufacturers, distributors, and dealers, but it eliminated confusion in the minds of consumers and simplified their purchases. Woven wire fence, especially that distributed through the trade, is economically designed, generally with close mesh at the bottom, graduating to wider meshes at the top, resulting in an efficient enclosure for small as well as large animals.

Fence efficiency is not entirely contingent upon the fabric itself; proper erection is of paramount importance, by reason of which some manufacturers are constantly striving to educate farmers directly and through dealers in the proper erection of woven wire fence. Manufacturers for the most part sell stretchers and other fence accessories to dealers at very nominal prices as encouragement toward this end.

[1]Paper presented before the Farm Structures Division at the 29th annual meeting of the American Society of Agricultural Engineers, at Athens, Georgia, June 17 to 20, 1935.

[2]American Steel and Wire Company. Affil. ASAE.

A COMPARISON OF TWO TYPES OF RURAL LINES. (LEFT) FOR RELIABLE AND ADEQUATE SERVICE. (RIGHT) FOR UNRELIABLE AND INADEQUATE SERVICE

Rural Line Construction and Operation[1]

By F. C. Weiss and L. M. Smith[2]

A PART of the confusion that is found in many studies of rural lines arises from the fact that a complete definition of these lines covers diverse parts of electric property. Yet many speak of an average specification and an average cost per mile or per customer. In a serious study of rural lines, each project is a problem just as each farm is a problem. In spite of this, it is a rare paper on the subject that does not boldly state what the averages should be, without giving any comprehensive definition, and on study you will find that the writer has omitted certain items that are essential to a complete specification or cost estimate.

Many worth-while articles are available on the subject of rural lines. However, in some you will find that the writer begins by describing the line as a substandard one. In other cases, the costs are given for the line only and provide no transformers, secondaries, or services. Frequently the cost of rights-of-way, surveys, and clearing are entirely omitted. Rarely is any dollar estimate given for the preliminary expenses, commercial surveys, customer's analysis, or even for tools, equipment, engineering, or supervision.

To clear the way for a brief discussion of rural-line specifications for the overhead type of construction, it is well to review some of the general considerations that must be met before the engineer has a complete picture of the problem before him. Suppose we start with a definition. Rural lines are broadly considered as service lines of relatively low voltage distributing electricity in sparsely settled territory. They may also be defined as supplementary to urban lines serving metropolitan areas. However taken, a rural line may serve all classes of customers of electricity, including farmers.

Now the problem of making electric service available to people in rural areas having low living standards may become confused when compared with the problem of providing service to dairies, resorts, small mills, irrigation projects, summer homes, and suburban areas. Many rural lines are apt to have customers of all of these types, and the design of such lines is materially affected by loads of this nature, some of which are seasonal, and they must be capable of giving service to all of them.

Typical treatment can be given for each element of a rural line project, but let us define a rural line as an overhead tap line fed from some convenient source of electric supply, serving farmers residing along a section line road. This is not any average line, but is apt to be a minimum, considering the United States as a whole. The factors governing the construction and operation of this tap rural line are as concise as in any other engineering problem, and you must have

1 An adequate and regulated source of power supply
2 A clear route for the line
3 Poles, fixtures, wires, equipment, etc., assembled in a substantial way
4 Customers who have not only the desire but the intelligence to properly use electric service
5 An operating organization.

The ultimate success of many rural projects is not at all assured when the requirements of maintenance, operation, commercial and utilization activities (not to mention capital expenses, taxes, and the like) are set down against the actual income.

The pioneer in distribution engineering was a practical-minded man. He had to make his business pay its way. He solved the problem of distribution to customers near his source of power supply. Extensions were then made to outlying subdivisions and to the dairy and truck farmers. This pioneer soon found that the suburbanite and also the dairy and truck farmer were not only human and wanted good service, but that unless such service was available they could not successfully use electricity. Good service from substandard lines and equipment was seen to be an impossible condition. Any attempt today to foist them back on a rural market would be a backward step.

The aggressive operator in his time took the challenge to serve all classes of business and built lines into rural areas, getting such support as could be obtained from local industrial loads. He saw that in some areas the farmers could use electricity to increase the earning power of their farms, and this meant customers who could be helped to build up the economic level of the territory. It was prudent business and good citizenship for the aggressive operator to spend more on the line to these farmers than the

[1]Paper presented before the Rural Electric Division at the 29th annual meeting of the American Society of Agricultural Engineers, at Athens, Georgia, June 17 to 20.

[2]Alabama Power Company.

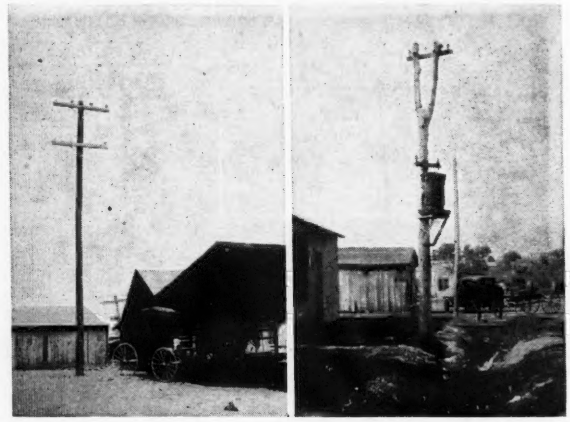
revenue would immediately justify. Tens of thousands of rural customers have been served by utility operators in the South in recent years. Many of these extensions have justified the early faith of the builder. His was no helter-skelter program. He studied each area and each prospect in the area. He studied his own equipment and planned the economic use of it to give reliable electric service to the farmer. Do you know what happens if the power is off on a farm circuit for 30 minutes, for 30 hours, for several weeks? Would you design a service to an electrified farm that would be subject to serious outages? No experienced operator would.

He had to build reliable lines in rural areas as inexpensively as possible, but adequate to supply the maximum expected use. Some conditions encountered in the rural areas proved useful in minimizing the line investment. The arbitrary requirements imposed by city hazards were absent. The number of poles required per mile of line was reduced, although each one had to be hauled further to the place of erection. The longer spans gave cause for wider spacing of primary wires, which could then be used without the insulating covering. The long spans led to a redesign of wires for rural service which did not, as a class, have to carry as heavy currents as their urban counterparts. The problems of voltage regulation were also simpler than on a complex network. This simplification of equipment could not, of course, be carried too far, or the maintenance crews would find the line a constant source of complaints and expense.

All property extensions depend on money and men. Let us look at the man part of this problem and assume the funds are at hand. Planning the extensions requires commercial surveys by men who have a broad knowledge of rural economic factors and some ability as salesmen—a good field for agricultural engineers. It is their job to sell the need for electric service and assemble reliable data regarding both immediate service requirements and possible growth. This commercial survey is a vital cog in the ultimate success of any project. Overestimates may be expected from men poorly trained in this work, and extensions built on such estimates will wreck any group that takes the financial responsibility for their success. Almost equally injurious is an underestimate of the customers' demands.

The distribution engineer then takes the commercial survey and begins the designs of the extensions. Men who are competent in this field of work are generally technically trained, and, in addition, have a broad field experience in the construction and operation of electric properties. Their designs are apt to be proven types that have been adapted to all classes of electric distribution. The adaptations with detailed designs must be available to the operator who will later have the property in charge.

The detail design of rural lines in some areas is monotonously uniform. In general, the distribution engineer and the crews must finish detail designs at or along the job. Trained crews, especially the foreman, are the key to such construction work. These crews have many problems not encountered on concentrated jobs. They must be composed of efficient and safe workmen. As much of their work is on private property and on highways, they have many public contacts, and a good personality in such circumstances is essential. Large-scale construction of rural extensions, as in every other class of construction, calls for planning the various parts of the work, routing of men, equipment and materials. These lead back to a management problem, the personnel of which must be experienced. Small-scale projects undertaken on a self-help basis must lean on talent such as described above, both as to designs and work. With the best of intentions, the 5-and-10-cent store or the mail-order catalog cannot give you an electric distribution property that will protect your family, your friends, your investment, or give permanent and economical service.



IN THE SHADOW OF ADEQUATE (LEFT) AND INADEQUATE (RIGHT) RURAL LINE CONSTRUCTION

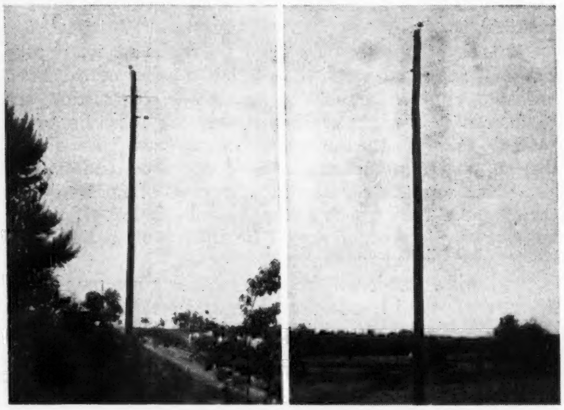
Speaking of service brings up the everafter period, as distinct from the planning and construction era. What do you expect in the way of service? You want the minimum of interruptions and voltage control suitable to your needs. Such of the system as is in and around your farm and roads, must be kept in good condition to be able to give continuous service and not be a hazard to life and property.

Unless you are receiving good service you will not know what to expect if the power goes off just before cooking dinner, or with a batch of eggs in the incubator, or while you are cooling perishable products, and good service will measure the use made of electricity by any progressive customer. The group that operates in your territory must be able to assure you such service. To do this they will need storerooms, materials, automotive equipment, tools, operating records, and office space. Generally, in rural areas they sell, and must be able to service, all classes of appliances and equipment used by the customer.

They must also have sufficient financial resources to do these things and survive contingency hazards. Such problems as relocating lines because of road changes are expensive and frequently encountered. Disastrous sleet storms or wind storms can be expected. In addition to financial resources, a trained personnel and adequate equipment are needed and these cannot be picked out of thin air. It is a practical problem of no mean proportions to develop an operating group, and the expense of so doing must be met by the customer.

The distribution engineer then, having in mind these broad general problems of construction and operation, must also be on his guard in the design of a rural line because it involves a study of transient and not static phenomena. The loads to be served are not fixed but are constantly changing, customers come and go, and the line may be extended far beyond that originally planned. Under such conditions, the economic phases of the project must be closely observed if a successful and profitable development of the territory is accomplished.

Before detail specifications can be prepared for a rural line, it is well to have full knowledge of the load possibilities in the area to be served. In this connection, it will generally be known in advance that the more dense sections



A MODERN SINGLE-PHASE, COMMON-NEUTRAL RURAL LINE
(Left) Primary and secondary at branch point in line. (Right) Primary line on 35-foot ASA Class 7 poles, using No. 4 ACRS conductor with 500-foot spans

have already been served, that the kilowatt demand per mile will be small even after an intense sales program, that the distances will usually be great, that the customers will be scattered rather than grouped, and that suitable power sources are likely to be outside of the area under consideration. With this advance knowledge, the assumption can fairly be made that a line constructed on minimum electrical specifications will be sufficient. However, the selection of the type of line actually to be built into a new area will not be made in this off-hand manner. Rather all of the facts that have any bearing on the construction and operation of the line, both initially and in the future, will be given due consideration.

Among the first of such facts that the designing engineer must face are the probable kilowatt demands of the individual customers, the diversity in demands between customers, the number of customers per mile, and how they are distributed. As to the load on the line, it is usually safe to assume that the customers will not make a heavy initial investment in all available appliances, although as the advantages of electric service are realized many of the customers will be prospects for refrigerators, ranges, hot water heaters, pumps, incubators, brooders, soil heating, feed grinders, and the like. Some few customers will be prospects for dairy equipment, and now and then service will be required for cotton gins, grist mills, and other semi-industrial or commercial loads.

At the present time, a limited amount of information is available as to the maximum kilowatt demand of a rural customer who makes generous use of electric service. Until sufficient information of this kind has been collected, it will be necessary to make certain assumptions in order to arrive at the estimated demand. In making these assumptions, it is helpful to know, of course, that the diversity in demand for an individual customer increases as the number of appliances in use increases, and that the diversity in a given mile of line increases as the number of customers increase. If you assume, then, that the average annual consumption of a rural customer is 1,000 kilowatt-hours and that his load factor is 15 per cent, you will find that his individual maximum demand will be around 770 watts. In like manner, if you assume that the average annual consumption is 2,500 kilowatt-hours with a 20 per cent load factor, you will find that the individual maximum demand is approximately 1.5 kilowatts.

Now, in order that this individual demand can be translated into demand per mile of line, you must make another assumption as to the diversity factor for the various customer demands in that mile. With five customers per mile and a diversity of three, the demand for all of the customers in that mile will be 2.5 kilowatts. It is quite probable, of course, that due to the customer's equipment the maximum demand will be considerably in excess of this figure.

After making the best possible study of the amount and type of load to be served, it is well to establish within reasonable limits the permissible voltage drop that will be allowed in the new line. In determining these limits, due consideration will be given to the voltage regulation in the facilities to which the new line will be connected. If this regulation already approaches the limit of tolerance, satisfactory voltage conditions on the new line may be impossible without special equipment.

In regard to permissible voltage drop, practices vary from place to place, but a range from 112 to 124 volts at the customer's meter will generally be satisfactory for lighting and for the operation of appliances now on the market, including electric ranges. Good voltage regulation is important to many devices, but it is especially so to heating devices. Recognition must be taken of that fact and also of the fact that since the advent of the electric refrigerator and other motor-driven appliances, numerous difficulties with certain makes of equipment have been encountered due to objectionable lamp flicker caused by excessive motor-starting currents. To remedy this condition, many efforts have been made to require manufacturers to so design their motors as to limit these excessive starting currents in both fractional and integral horsepower sizes, but as yet these efforts have not been entirely successful. Thus does the problem of securing and maintaining good voltage regulation become more difficult, and in decided contrast with the problem just a few years ago when the electric lamp and the simplest of appliances provided the principal load.

After the best possible estimate has been made of the loads to be served, now and in the future, and some limit for voltage regulation has been established, it is in order to consider some other elements of the problem. One of the first to be considered is the voltage at which the line should operate.

In general, rural lines will be built for operation at whatever voltage has already been established in the area. This is the natural, and usually the most economical, plan to follow. You will note, however, from the curves in Fig. 1 that there is a rather definite limit to the length of lines that may be operated at 2300 volts. This voltage then is usually not satisfactory for a rural system, but where it exists the installation of a step-up transformer to provide a higher voltage for the rural line will often be found satisfactory. For such voltages as 6900 and 11,500, no such limitations exist unless the length of line and the loading exceed that to be expected from the areas not now receiving service. The use of the curves referred to, or others prepared for different assumptions, will assist in selecting a satisfactory voltage for the primary line and will indicate whether it should be of single-phase or three-phase construction.

Assuming that the voltage for the line has been selected, or otherwise determined, it is in order next to select the conductor for the primary. As pointed out previously, the maximum demand per mile of rural line is usually rather low, so that from the standpoint of load-carrying ability small conductors usually have ample carrying capacity. The selection of a conductor, therefore, will be such as to keep the voltage drop within the limits set. Since this

voltage drop is due to the load, the length of the line, the spacing of conductors, and the size of the conductor, the conductor size becomes the only variable since the other factors are fixed. The minimum size conductor which will generally be satisfactory from the standpoint of carrying capacity on rural lines is No. 6 copper, or its equivalent. In a few cases the increased cost for No. 4 copper, or its equivalent, will be found economical.

The initial construction of rural lines will usually be made with the minimum size conductor that will be satisfactory for the span length selected. In certain areas, however, it is to be expected that at some time in the future loads will increase, or that as the line is extended the drop in voltage will be greater than can be permitted. When this condition occurs, the capacity of the line can be increased in one or more of four different ways, and it is usually well to have some one of these plans in mind when the line is originally constructed.

One of the simplest ways of increasing the capacity of a given line is through the installation of regulating equipment. At the present time, there are seven types of equipment which may be used on rural lines to secure improved voltage regulation. They are the induction regulator, load-ratio control equipment, the step voltage regulator, the branch-feeder step voltage regulator, the branch-feeder step voltage booster, the shunt capacitor, and the series capacitor. Each of these devices is particularly suitable for the correction of certain specific conditions, and they should be applied only after careful consideration of all pertinent facts, and with due regard to the economic benefits they may provide and to the effect their installation will have on the goodwill of the customer.

The second way of increasing the capacity of a rural line is by adding a third conductor and changing the system from single-phase to three-phase. From the curves in Fig. 1, the possibilities of carrying greater loads for a greater distance by this change are apparent.

The third way of slightly increasing the capacity of an existing line, is by changing the conductor size. This is usually not economical, as the benefits are small and the interruptions in service to the customers while the change is being made will be very annoying.

The fourth method which may be used in some cases, but which also is expensive, is that of raising the voltage on the line by means of a step-up transformer.

With the voltage of the line determined and the conductor selected, it next becomes necessary to look at the various elements making up the mechanical design of the line, such as the kind and height of poles, the length of span, and the route the line is to take. In this procedure the rules of regulating bodies having jurisdiction will generally be followed.

A rural line should consist of straight sections with few angles and few long curves, in order to eliminate as many poles and guys as possible.

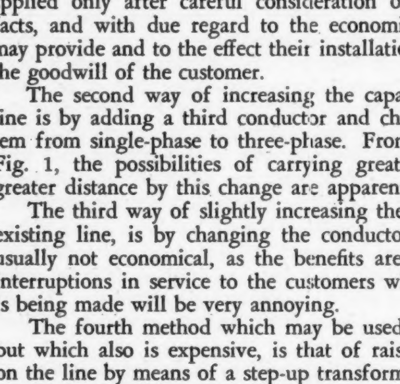
The line should be built along the highway, where practicable, in order to reach the greatest number of customers with the minimum amount of service line construction, and to later supply highway lighting on the most important routes. This construction along the highway, or adjacent thereto, will minimize the cost of operation and maintenance and reduce the outage time in cases of failure due to the ease with which such failures may be found. If private right-of-way is used, it should be fully protected by easements or approved agreements.

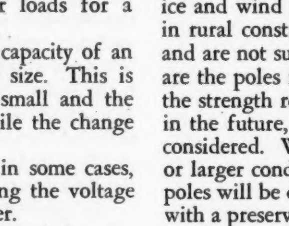
In some cases, it will be necessary for a communication line and the rural line to occupy the same side of the highway. In this case, the rural line may be built over the communication line, or joint use construction may result where terms and conditions can be agreed to. Usually, however, the long spans specified for a rural line are not suitable for telephone circuits.

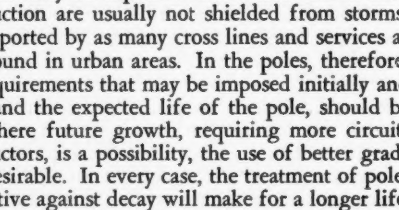
In the matter of span length, one of the striking characteristics of modern rural lines, especially in the South, is the use of pole spacings of as much as 500 to 600 feet, as compared with 150 to 200 feet of a few years ago. These long spans require conductors of sufficient strength to allow them to be strung at such a tension as will not require excessive sag and thereby high poles to maintain safe ground clearance. Because of these strength requirements, or because of the high poles that would be required, some conductors that may be ample in carrying capacity will be found unsuitable and uneconomical.

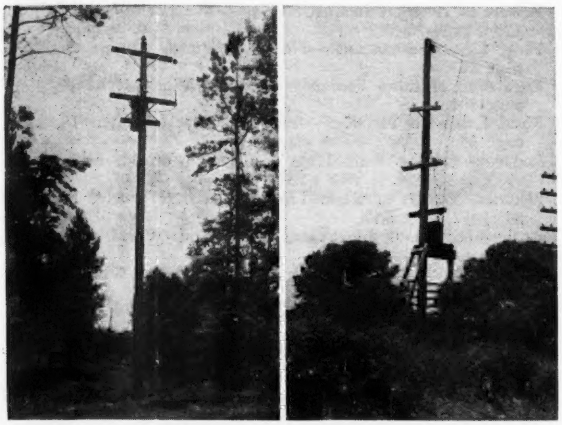
The selection of the proper size pole for the line will not be difficult if the ASA (American Standards Association) classification is used. The height will be determined by the clearance required between the conductor and the ground at the lowest point of sag, and when loaded with ice and wind that may be expected in the area. Poles used in rural construction are usually not shielded from storms, and are not supported by as many cross lines and services as are the poles found in urban areas. In the poles, therefore, the strength requirements that may be imposed initially and in the future, and the expected life of the pole, should be considered. Where future growth, requiring more circuits or larger conductors, is a possibility, the use of better grade poles will be desirable. In every case, the treatment of poles with a preservative against decay will make for a longer life.

Due to the small number of customers served per mile of line, the greater portion of it will consist only of the poles and the primary conductors. At times, however, the customers will be so grouped that a certain amount of secondary construction will be required. In general, this problem will be handled in much the same way as the primary construction, as regards the use of conductors ample for the secondary load and of such strength as









TWO TYPES OF TRANSFORMER INSTALLATIONS. (LEFT) FOR RELIABLE AND ADEQUATE SERVICE. (RIGHT) FOR UNRELIABLE AND INADEQUATE SERVICE

will maintain clearance to ground when suspended from the poles set for the primary line. These secondary conductors may be carried on cross arms or racks below the primary conductors, or in the case of single-phase common neutral construction on spools mounted on the poles with bolts.

Guys should be installed whenever the unbalanced loads on the poles are greater than that which can be safely carried, such as at corners, dead-ends, at angles in the lines, at railroad crossings, and other similar situations. As pointed out previously, however, the route of the line should be so selected that the number of guys required will be reduced to a minimum.

Grounding is another element in rural line design that should be given careful attention. Water piping systems are not usually available, and in many places the soil resistance is so high as to present serious problems affecting the safe operation of the line and the satisfactory performance of lightning arresters. Without the benefit of water piping systems, driven grounds will be necessary at all lightning arrester installations and for the secondary neutrals. In the common neutral type system, the grounds for arresters and secondary may be common. Such grounding will usually be accomplished by the use of rods or pipes driven near the poles. For best results, a sufficient number should be used and driven to adequate depth to provide not over 25 ohms total resistance. In many locations, treatment of the soil around the rods or pipes with salt may be necessary to secure sufficiently low resistance grounds for the best operating practice.

Transformers suitable for rural circuits are available in three general types—the conventional, the surge-proof, and the rural—this latter being a recent development in small sizes for low voltage lines. The conventional transformer will usually require arresters and fuse cutouts for its protection, especially in the South, where thunderstorms are common. The surge-proof transformer does not require these items, and they are optional with the rural type. The present so-called rural type, however, is of such design that in case of lightning or any excessive voltage an external gap on the cover will flash over and cause a line outage. Unless the line supplying such transformers is served through an automatic reclosing breaker or repeater fuses, these flashovers may cause many interruptions of long duration.

This brief discussion of some of the major elements in rural line design is not intended to minimize the attention that should be given to other elements that may, and often do, have an important bearing on the total cost. The type of hardware that should be used, the kind of meters that will be installed and the method of mounting, the type of house service construction that will be followed, and like problems, will be given careful thought. The use of low-grade materials, poor workmanship, inadequate guying and depth of pole holes, laxity in securing privileges for pole and anchor locations and tree trimming rights, usually dc not make for a satisfactory line.

Any discussion of rural line design would be incomplete without some reference being made to the estimated cost of construction and operation. As pointed out previously, much of the present confusion as to what rural lines should cost is due to the fact that many of the articles which have appeared on this subject have been based on minimum costs, and on the assumption that the construction would be done under the most favorable circumstances without encountering many of the situations that arise in actual practice. In some of the articles, it is obvious from the type of construction proposed that the operating cost of the line has been largely ignored.

In order that the general relations between the cost per customer and the number of customers per mile may be better understood, the curves in Fig. 2 have been prepared. From these curves prepared from a single set of assumptions, it will be seen that regardless of the primary line voltage these general relations remain approximately the same as the customer density changes. The curves also show how rapidly the cost per customer mounts as the number of customers per mile decrease. In Fig. 3, a comparison is made to show the relative costs of various elements making up the total cost of a typical mile of line with 4 customers, and with 8 customers, per mile.

While these general relations will hold for many rural lines, situations do arise in actual practice which materially increase the cost of providing service to rural customers. Some of these situations are as follows:

1. Necessity of building a substation solely to serve a rural line. (The cost of this substation is as much a part of the necessary construction as the rural line itself.)
2. Use of private right-of-way for which payment must be made
3. River crossings
4. Railroad crossings
5. Crooked or unimproved roads and of undetermined width, making the survey of the line expensive
6. Bad tree conditions
7. Necessity for the use of service poles
8. Poles set in rock
9. Bad weather during the construction period
10. Distance of work from crew headquarters
11. Piecemeal construction due to delays or poor load factor on the crews
12. Unusual diversity between customers
13. Unusual demands in kilovolt-amperes per customer
14. Equipment to maintain proper voltage, either at the substation or in the line
15. Line sectionalizing equipment to separate that section of line that may be in trouble
16. Inductive coordination with parallel communication circuits.

Aside from the factors making up the construction cost of a rural line, the annual expense of operation and maintenance is another matter that may be easily overlooked, especially where an effort is made to build lines of minimum first cost. In this matter of operation and maintenance, you will remember that a rural line will usually be located remote from operating headquarters and that certain items of operating expense will be greater than for a similar investment in urban areas. Some of the items which may

be adversely affected in this respect are the expenses for operation, maintenance, renewals and retirements, and sales. Also with anything but first-class construction there are possibilities of damage claims for injuries that may result from line or equipment failures not immediately brought to the attention of the operating personnel. It is necessary, therefore, that these and other factors affecting the annual cost be given due consideration.

In concluding this discussion, it is thought appropriate to suggest briefly some probable requirements for the near future that may appear. As the advantages of electric service develop and as the economic status of the individual improves, customers on rural lines will become more and more dependent upon electric service, and as this dependence increases they will be less tolerant of interruptions than they now are. This would indicate that a high degree of reliability in rural line service will be demanded. As the loads increase and as various appliances are added, particularly motor-driven appliances, better voltage regulation will be demanded. How this demand will be met should be considered prior to the initial construction. It may be expected also that demands will appear for highway lighting, particularly where lines have been built along improved thoroughfares. Demands are almost certain to appear in the future, as in the past, for service extensions further into areas heretofore considered a bad risk.

From these suggestions as to rural-line construction and the problems yet to be faced, it is not to be inferred that further reduction in costs of rural lines is impossible. On the contrary, as the opportunity affords several avenues are open for further economies. Some of these avenues, for which distribution engineers have been working for some time, are as follows:

1. Further improvement in standards of design that will result in savings on the most widely used assemblies and on field labor due to simplification
2. Better selection of poles as to strength, depth of setting, etc.
3. Greater use of bare wire
4. Better loading of transformers, resulting from a more accurate engineering knowledge of rural loads
5. Elimination of unnecessary arresters and cutouts and the fixtures required for mounting them
6. Use of low-cost voltage regulating equipment where dependable field data indicates it to be desirable
7. Intelligent engineering of each construction job with a proper distinction between the requirements of urban and rural service
8. Prompt abandonment of practices that are not justified by experience in being continued
9. Continued cooperation with groups engaged in research and in standardization.

Always with the goal of good quality at low cost before him, the distribution engineer will continue in his efforts to that end, and in cooperation with the agricultural engineers will strive to make the comforts and conveniences of electric service as widely distributed as good business judgment indicates is possible.

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* * *

Recommended General Specifications for Single-Phase, Common-Neutral Rural Lines

These specifications provide a serviceable and inexpensive assembly of standard tested line materials and merit nation-wide test applications. The electrical features are simple and adequate for light loads. While lines of this class and design have been in service for several years with good operating records, the design has not been tested by wide application.

These specifications are intended to cover the general features of design and construction of common-neutral rural lines operating at 15,000 volts or less. While designed basically for single-phase primaries, this type of line may be converted to a three-phase, four-wire line by the addition of a cross arm and two primary conductors.

Location. The line beginning at an adequate and regulated source of power shall extend along the margin of a road where possible and on the side which has the fewer obstructions. In some cases it may be more economical to use private right-of-way which can be secured as a donation from the customers benefited, and without cost other than the acquiring and recording of easements.

Tree Trimming. Where necessary to secure clearance for the conductors, trees shall be trimmed in an approved manner such as to provide a five-foot clearance to the primary conductor. Where possible, account should be taken of the rate of growth for the various types of trees encountered.

Poles. Poles shall be of dense southern pine, pressure treated either with creosote or zinc meta-arsenate. The creosote treatment shall be 12-pound open cell, using a mixture of 80 per cent No. 1 AREA oil, and 20 per cent refined coal tar. The zinc meta-arsenate treatment shall be by Curtin-Howe standard specifications, using 1/4 pound of salt per cubic foot of wood. Other native woods of competitive qualities may be substituted.

The design is based on a pole height of 35 feet, where primaries are carried on the poles. Where secondaries alone are carried, 30-foot poles may be used. Poles to support services only will, in general, be 25 or 30 feet long.

Poles shall be ASA Class 7 where they must carry primaries and secondaries, or where they carry primaries only with the expectation that secondaries will be added later. Where no secondaries are expected, ASA Class 9 poles may be used. Poles for secondary and services only shall be ASA Class 10.

Conductors. Primary, secondary, and neutral conductors shall be bare and shall have electrical and mechanical characteristics not less than that provided by No. 4 ACSR. Where ACSR conductors are used they shall be protected at insulator supports by armor rods or ribbon to prevent damage to the conductor from vibration, abrasion, or burning.

Conductors shall be strung to a maximum tension of 60 per cent of their breaking strength. The design loads should conform to the safety Code requirements for the locality being served.

Insulators. Insulators shall be of the types and ratings used in ordinary distribution construction.

Span Length. Where primaries alone are strung and no further secondaries are contemplated, span lengths on level ground shall be from 450 to 500 feet. Where secondaries are strung originally, or are contemplated at a later date, spans shall vary from a minimum of 350 feet to a maximum of 450 feet.

Span lengths will necessarily vary considerably, depending on the contour of the ground. The above assumptions are based on level ground and ground clearances as required under the controlling code and should not be less than 18 feet.

Guys and Anchors. Guying shall be as simple as the mechanical features of the line will permit. Storm guys shall not be used except where conditions are known to exist that warrant their use.

Guy wires shall of the two following types: ¼-inch 3-strand Seimens Martin, and 5/16-inch 7-strand AT&T 6000-pound messenger.

Anchors for ¼-inch guys shall be 3000-pound patent type and for 5/16-in guys shall be 6000-pound patent type.

Transformers. No particular requirements are necessary for transformers, except that care shall be used to proportion them to the loads to be served and to see that proper protection against lightning and overload is provided.

Meters and Services. Meters shall be universal detachable socket type mounted on the outside of the building and connected to the incoming service wires with concentric service cable.

Services shall be of No. 8 copper equivalent as a minimum, strung at a safe height above ground to the nearest suitable point on the customer's house.

Sectionalizing Equipment, Grounds, etc. Where the line is of considerable length, or has long branch circuits, consideration shall be given to the installation of switches or fuses to allow for prompt sectionalizing in case of trouble.

Ground rods or pipes shall be driven at each transformer pole and at the next adjacent pole on each side, and shall be connected to the neutral conductor. These grounds are in addition to those installed by the wiring contractor on the customer's premises.

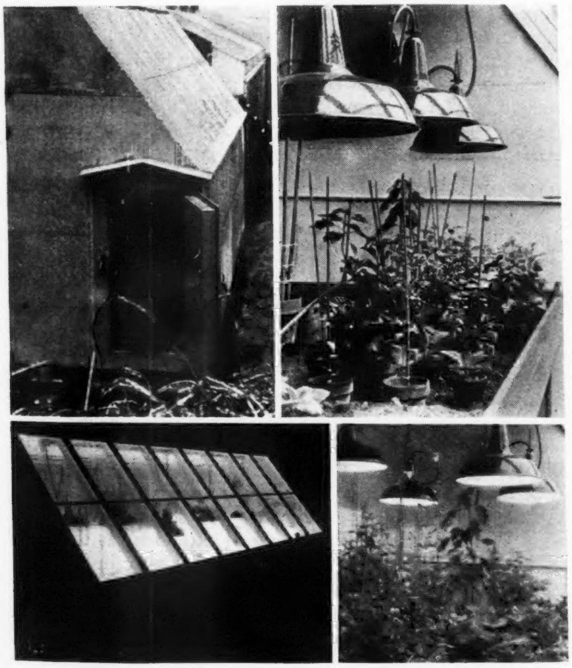
A Heat Insulated Greenhouse

By Lawrence C. Porter[1]

THE TREMENDOUS growth of the florist business has been accompanied by extensive research pertaining to plant physiology, soil sterilization, nutrients, insect control, development of new varieties, etc. This has resulted in more and better plants and lowered cost of production. Little attention has been given to fundamental changes in greenhouses; most greenhouses involve the same general principles in use a hundred years ago. They are still built almost entirely of glass with little attention given to the tremendous loss of heat in winter and the excessive heat and light intensity in summer. Little attention has been given to the pitch of the roof even though there is considerable light loss due to surface reflection.

Last year a radical departure from common practice was tried out at the Boyce Thompson Institute of Plant Research at Yonkers, N. Y.[2] There in cooperation with the General Electric Company and the Westchester Lighting Company, a greenhouse was constructed having its sides, ends, floor, and half of the roof made of heat-insulating materials entirely opaque to light. The single row of sash on one side of the roof was made of large panes of glass 24 inches wide by 32 inches long set in putty and pointed to form airtight joints. In order to admit the maximum amount of light during the winter months when daylight and sun intensities are lowest, the sash was set at an angle of 52½ degrees to the horizontal. This setting places the glass in a position normal to the suns rays at noon half way between the autumnal equinox and winter solstice and again between the winter solstice and the vernal equinox, i.e., on November 5 and February 5. In order to utilize the natural light to maximum advantage, the entire inside of the house was painted white.

[1]Illuminating engineer, General Electric Company. Mem. ASAE.



(TOP, LEFT) END VIEW OF INSULATED GREENHOUSE HEATED AND LIGHTED BY MAZDA LAMPS. (BOTTOM, LEFT) A NIGHT VIEW OF THE HEAT-INSULATED GREENHOUSE THROUGH THE STORM SASH. (TOP, RIGHT) THIS SHOWS THE PLANTS PHOTOGRAPHED IN THE HOUSE ON DECEMBER 29. (BOTTOM, RIGHT) THE SAME PLANTS ON FEBRUARY 9, OR 42 DAYS LATER

The house was equipped with 300-watt Mazda lamps, and the heat from these lamps was the only heating aside from the radiant energy of the sun used in the house. The lamps were controlled by a thermostat set to maintain the temperature between 62 and 68 degrees per cent Fahrenheit. Under these conditions even in zero weather the lamps never burned when the sun was shining. On dark gloomy days the lamps burned occasionally. During the night with zero temperatures outside, the lamps came on about every half hour, burning on an average approximately 10 minutes at a time. In general the total lighted period was about four hours in each twenty-four. This happens to be just about the right amount of supplemental lighting to be of greatest benefit to the plants.

Various flowers were raised in this house in comparison with similar plants raised in a conventional all-glass type of greenhouse. The plants in the heat-insulated greenhouse grew larger and faster than the controls. Snapdragons, for example, bloomed 8 weeks earlier in the heat-insulated house than in the regular one. The dry weight of buckwheat plants grown between December 10 and January 25 was almost three times that of similar plants raised in a regular greenhouse.

It is believed that these experiments may revolutionize greenhouse practice. When houses of this sort are fabricated in the factory, then initial cost should be considerably lower than that of the conventional all-glass type. Since there is no heating equipment to purchase and maintain, the operating costs should be lower. There are already two concerns prepared to furnish heat-insulated greenhouses commercially.

[2]Contributions from Boyce Thompson Institute, vol. 7, no. 2, pp. 131-146, 1935.

Ionization of Farm Animals and Crops

By J. W. Pincus[1]

THE UTILIZATION of electricity for ionizing the air has received more attention in Russia than in any other country. This is due to the indefatigable efforts of a Russian scientist, Professor Doctor A. L. Tchijevsky. Some of his interesting conclusions on the use of ionized air upon domestic animals are given here.

Experiments with Cattle. The experiment with dairy cattle was carried on on the Soviet farm "Molochnoye" located on the Northern Scientific Research Dairy Institute at Vologda. Eighteen milk cows were selected, and after 23 days of preliminary observation, the cows were exposed for 47 days to ionized air. Then for 24 days the treatment was stopped to observe the influence of ionization, and the test was continued for 22 days again. The "dose" of ionization was started for 10 minutes per day, and gradually increased to three hours, and the kilowatts were increased gradually from 50 to 95. The dosing was divided into two equal periods, one in the morning and one in the evening. As we do not have the space to go into detail description of the results, we shall mention only the general conclusion of Prof. Tchijevsky and his associates who conducted this experiment: "Ionized air unquestionably produces satisfactory action on the organism of cows and on their milk production. This action is shown in (1) increase of live weight of animals; (2) increase of daily milk production; (3) favorable fluctuation in the butterfat and protein content of milk; (4) influence on the sexual cycle (the period of heat in cows being contracted from 21 to 19.8 days); (5) the increase of absolute numbers of hemoglobines and quantities of eritrocytines in the blood, and (6) to increased catalysis.

Experiments with Hogs. Experiments with hogs were conducted on the Soviet hog farm "Veshky," located near Moscow. 140 head of hogs were selected and divided into two equal groups of 70 each, selected equally as to age, size, etc. The results are summarized as follows:

1 The smaller and weaker pigs showed a larger percentage of increase in weight, etc., under ionization.

2 The prophylactic influence of ionized air was particularly marked. In septicemia, with which hogs were badly affected, 42 per cent died in the untreated group, and only 12 per cent in the ionized group.

3 Some prophylactic action was also shown in eczema of the hogs.

4 Ionization also showed favorable results on the appetite of the hogs, their activity, and their heat.

Experiments with Sheep. For experiments with sheep the large Soviet sheep farm "Bolshevik" located in Northern Caucaus was selected. Here 20 ewes and 40 rams were ionized and a similar group was left as a control group. The results are summarized as follows:

1 In the ionized flock, there was not a single case of death during the 3½ months experimentation, while in the control group there was 20 per cent of death.

2 While the gain in weight was not uniform, and due to many unsatisfactory conditions of the experiment, careful observations and conclusions are not possible, still Prof. Tchijevsky claims that the ionized sheep showed a slight gain.

3 The influence on the quantity of wool was quite marked. The ionized ewes gave 18.6 per cent more wool than the control ewes. The larger the animal, the greater the percentage of increase.

4 Some improvement in the size and quality of wool was also observable.

In view of the rather doubtful results of the first experiment, the experiment is being continued with 1,000 sheep.

Experiments with Poultry. Among the first large-scale experiments of ionization was done on poultry, first at the Soviet poultry farm "Arjanka," later at the Zagorsk Poultry Institute, and now continued on a very large comprehensive scale at Voronej, at the special experimental ionification laboratory, established for Dr. Tchijevsky on the grounds of the agricultural school and institute of Voronej. Here experiments were conducted with mature birds, day-old chicks, pullets, and incubated eggs. It would take entirely too much space to discuss fully these experiments, as their results comprise nearly 250 pages in Tchijevsky's report[2]. The following condensed abstracts from this report gives the most important conclusions:

In the experiment with 671 chicks hatched in February, subjected to ionized air for 1½ hours daily, the ionized chicks had less losses (2½ times) during first two months (February 18 to April 18), less sickness in ionized (lack of vitamines), or, as the Russians call it, "avitaminoz." On June 5, the ionization was stopped and all the chicks were put in runs on June 21 and careful observation was made of them. On July 18 the weight of the birds showed that the ionized chicks showed on an average 30.4 per cent more weight. After six months, the losses on ionized birds were 30 per cent, on untreated (control) birds, 70 per cent. Among other observation, Prof. Tchijevsky mentions

1 Feathering and thickness of feathers more marked in ionized chicks
2 More intensive accumulation of fat
3 Quicker maturity of ionized birds
4 Earlier start of egg laying in ionized birds
5 Considerable increase in the egg-laying capacity of ionized birds.

The second poultry experiment was continued from June 12 to September 9, and the purpose of this experiment was to determine the influence of different doses of ionization upon day-old to 3½-month-old pullets. The conclusion of this experiment is that the total live weight of the birds under ionization was from 20 to 60 per cent greater, depending on the various doses.

The third poultry experiment was started July 1 and continued until the following April 10, and was to determine the influence of ionization on egg laying in commercial flocks. One group was ionized for one-half hour daily, another four hours daily, and of course one group was a control (untreated) group.

While there were several negative influences, such as moulting, too cold in the one of the chicken houses, etc., still the hens in the ionized groups showed consistently larger egg yields than the control group. The short period of ionization showed better results than the long period.

The fourth experiment with poultry was to find out the

[1]International consulting agriculturist.

[2]Transactions of the Central Laboratory for Scientific Research on Ionification, Voronej Publishing House, The Commune, 1933.

influence of ionization on tuberculosis of fowls. 800 head of poultry were selected in "Arjanka" and observations were conducted for over a year. While the results are not conclusive, he comes to the following conclusion: "Evidently the ionized air of the experimental poultry house acts on the organism of the birds and assists them in combating tuberculosis, and thus hinders the development of the stimulant of this disease."

The fifth experiment with poultry was to ascertain the hatchability of eggs from ionized birds. Eggs from birds ionized for one-half hour, as well as those ionized for four hours showed, both on the 7th and 14th day test, that the embryo in ionized eggs was much stronger. The first group showed 23.8 per cent increase over the control group, and the second group 7.6 per cent more. The chicks from ionized birds showed more strength and vitality than the untreated birds.

In the sixth experiment with poultry, 240 chicks were taken from treated birds (both one-half-hour and four-hour doses) and untreated. This was to determine the doses of ionization and the influence on their progeny, the chicks. The most efficient dose was one and one-half hours from birds which had one-half hour dose. This group showed an increase of 70 per cent in total live weight. The four-hour dose had a depressing influence on the chicks.

Experiments with Incubated Eggs. In order to find the influence of ionized air on the embryo of incubated eggs, Prof. Tchijevsky conducted experiments at the Zagorsk Poultry Institute. 119 eggs of local breed and 19 eggs of Rhode Island Reds were placed in three incubators with a capacity of 150 eggs.

Incubator No. 1 started with a dose of three minutes, which was gradually increased every two days by one minute. The dose in the second incubator was started with six minutes and increased every two days by two minutes. The ionization was done twice a day at 7:00 a.m. and 7:00 p.m. Eggs were turned after the second day of incubation up to and including the 18th day twice a day. The testing of eggs (candling) was done on the 7th, 14th, and 18th days. The results are not conclusive, but the ionized eggs showed less mortality. Systematic observations of the chicks showed the chicks from ionized eggs had greater vitality and made greater gain in weight, and so it can be stated most positively that ionized air has influence on the development and vitality of the embryo.

Experiments with Plants. In the Sovkhoz "Marfino" located in the suburbs of Moscow, experiments were conducted with vegetables in greenhouses. The best results were obtained with cucumbers. With the 10-minute doses, the cucumbers gave twice as much cucumbers during the three harvests (pickings) as the "control."

Another very interesting experiment was with ionizing seeds (dry) for 5, 7½, 15, and 20 minutes, and here are Prof. Tchijevsky's conclusions:

1 Ionized seeds show greater energy of germination; at times the final germination was twice as high as the "control."

2 Ionized seeds germinate more uniformly and usually quicker, sometimes three to five days quicker.

Prof. Tchijevsky is developing better, quicker and more economical methods of ionizing seeds, and also the optimum doses of ionization for different seeds.

What Is the Agricultural Engineer's Job?

(Continued from page 468)

do so, the more rapid our progress should be. But this technical information and studies leading thereto should be considered as only the "tools" for the doing of the main job.

To clarify the distinctions which I think should be made between technical study and engineering, I find it easy to think of in this way: To construct a great building requires the cooperation of many technical experts—men versed in concrete technology, timber technology, metallurgy; in the services and utilities, such as electricity, water supply and sewage disposal, heating and ventilating; and, in some cases, such sciences as biology and meteorology. But the technicians and scientists, as such, no matter how expert, are not the engineers. The engineers are those planners and coordinators who assemble the various technologies and sciences into a working unit to solve a specific problem—in this case the construction of a building. Is it not true that agricultural engineering has hardly come beyond the technological stage?

How, then, can the profession advance into the next stage? The first step lies in the planning of programs for meetings—programs are what we talk about, and what we talk about we do. Consistent with the ideas expressed in the paragraphs above, I wish to make one or two suggestions concerning programs and subjects for discussion in the future meetings of the Society. It seems to me that, as the organization gets larger, as the work expands, and as the interests represented by different individuals become more varied, the work of program building will become both more difficult and more responsible for the direction which the profession may take. President Livingston has stated that it is his purpose to make the technical committees function more actively. This seems highly desirable. Might not some such plan as the following be adopted?

All papers on technical subjects and reports on experimental work should be submitted to the proper technical committee where they would be made the subject of intensive study. From the committee would come an evaluation of the importance and significance of the different contributions, so that those that are of most importance would find their way into division round tables. For the general meetings, at which members of all divisions are to be present, the program should consist of relatively few papers and much discussion dealing with agricultural engineering as an activity such as outlined above, that is, planning and coordinating—*managing agriculture.*

A plan was adopted at the October meeting of the North Atlantic Section to have the papers mimeographed and sent out to members as soon as possible after the close of the meeting. This is, obviously, a valuable step. Would it not be even more desirable to ask that the papers be mimeographed or otherwise published before the meeting so that at least a few persons could come prepared to contribute some really critical discussion? This might impose a little extra effort on the persons who are going to present papers, but it seems that the price would be amply repaid by the improvement in the quality of the discussion. I believe this early preparation and publication of papers preceding the meeting would be especially valuable in the case of those papers to be presented at the general sessions. Few persons can absorb the import of a worth-while paper and think out their own reactions to it rapidly enough to say what they would like to say or should say in the short time available. Would not such a plan help to make the meetings a time of discussion and interchange of thought rather than a time of listening?

NEWS

The Winter Meetings of the ASAE Technical Divisions

By Walter B. Jones

WITH a registration in excess of 320 the recorded attendance for winter technical division meetings of the American Society of Agricultural Engineers reached a new high mark at the sessions held December 2 to 5 inclusive at the Stevens Hotel in Chicago. The number of visitors who failed to register necessarily is a matter of broad estimate, but they surely must have brought the total close to 400. While gratifying, this enlarged attendance was no surprise, being in line with advance estimates.

Much of the new attendance must be credited to the meetings of the Rural Electric Division and the Soil and Water Conservation Division. Yet it would be wrong to assume that attendance at these meetings was measured by surplusage of attendance over previous meetings. The essential unity of agricultural engineering as a profession and as to subject matter was emphasized by the large number of men, especially among the college engineers, who repeated from division to division as the overlapping schedules permitted.

Hardly a complaint, but a frequent comment, was the remark that there were too many good things going on at once. It seemed to be recognized that the arrangements were an attempt, at least, at an optimum compromise between conflicting sessions and a prolonged meeting. Besides the offsetting of schedules, the arrangement of three joint sessions mitigated the conflicts and recognized the integral character of agricultural engineering.

Nevertheless, concurrency of programs makes impossible any pretense of complete review of subject matter by a single reporter. What is here written must be taken as random comment pending publication of papers, and glimpsed impressions of discussions, formal and informal, which always is a major reason for personal presence at meetings of this character.

The trend toward better balance, both among divisions and as to interest in subjects within the divisions, noted a year ago was again continued. Added to this was an air of stability and confidence that augurs well for our profession and for things in general. While activities by public agencies contributed substantially to the subject matter, the feeling of uncertainty as to possible reaction of governmental projects on industrial interests and prospects seemed to have largely subsided. In its place appears a greater appreciation and no doubt a better definition of public research, experiment, and extention as the ally of commerce.

An example of this march toward stability was the interest in "Safe Storage of Grain Under Seal on the Farm," a round table led by Wallace Ashby of the USDA Bureau of Agricultural Engineering. Its discussion brought out the view of some economists that grain can be stored and managed more efficiently in terminal or other elevators under professional supervision, and the opposing observation by others that in times when large quantities of damp grain are being harvested the refusal of buyers to take it except at ruinous differentials creates an eminently economic place for storage and conditioning facilities on the farm. Since stabilization may involve storage for a few years rather than merely months some speakers, notably Dean Walster of North Daklota, stressed storage in terms of biological processes in living tissue and the environmental factors which control them.

As the discussion developed, Vice-Chairman A. M. Goodman of New York suggested that, for drying or conditioning grain during or preparatory to storage, the previous practice of using heated air be discarded and refrigerated air be used instead. Some observations by F. C. Fenton of Kansas supported this theory, especially in cases where the temperature of night air dropped below the dew-point. Aside from the obvious physical relation of temperature to relative, and its limitation of absolute, humidity, the more important influence seemed to be that of temperature on the liberation of metabolic water. This discussion had to do mainly with wheat and hot weather harvest. Corn and cold weather harvest, especially when speeded up with mechanical pickers, were discussed as a sharply differing problem.

Meanwhile the Power and Machinery men were hearing about "Measuring the Forces on Soil Tillage Tools," in a paper by A. W. Clyde of Pennsylvania, formal discussion by D. C. Heitshu of the J. I. Case Company, and comment by Theo. Brown and others of the industry. The consensus emanating from that session was that the fundamental data derived from this and perhaps other similar studies would prove valuable in the design of more efficient implements.

A surprising degree of interest attached to the paper on "Patent Essentials," by G. D. Jones, patent counsel for the Cleveland Tractor Company. With the ensuing discussion some progress was made toward threshing over the tangled and delicate problems that arise from patents taken out by universities, experiment stations, and other public research agencies. Practical defects of the public service patent, and of some alternatives thereto, were cited, and if no solution was reached, at least the problem was defined.

Rubber tires, which for several years have dominated an entire session and attracted peak attendance, were represented by the paper, "Traction Tests with Pneumatic Tires," by C. W. Smith of Nebraska. Now, however, these tires seem to have taken their place as something accomplished rather than a striking innovation, and in consequence have yielded their lion's share of attention, dividing time with combines—in their heyday also revolutionary in attention value—and with soil wear tests reported by June Roberts of Kansas, also with pest and plant disease control developments as cited by R. M. Merrill, USDA Bureau of Agricultural Engineering and chairman of the Society's technical committee on pest control.

Following the Monday afternoon session, devoted to recent developments and applications to farm building practice of concrete construction by W. G. Kaiser of the Portland Cement Association and of lumber by F. P. Cartwright of the National Lumber Manufacturers Association, also a progress report on paint tests for galvanized surfaces by G. C. Bartells of the American Zinc Institute, the structures engineers went into a last-minute conference with a number of poultry science men (who happened to be in the city at the same time) looking toward the betterment of poultry house plans, and particularly better adaptation of recommended designs to governing conditions. Consideration was given to climatic zoning in preference to state lines, to better definition of adaptation in the descriptive matter accompanying plans in the catalog, and to the wisdom of modifying the Midwest list by additions and deletions where conditions seemed to justify. Steps were taken looking toward more effective working cooperation with poultry organizations.

The structures session that evening was scheduled as a round table on "Cooperative Building Plan Services," but this reporter diverted his attention to the Materials Committee meeting which resumed its perennial wrestling with metals for plowshares and other tillage members, a perplexing confusion of Brinell numbers, price per pound, soil properties, and rural blacksmith practice. While no nutshell summary of this can be made, it may be said that it becomes increasingly clear that more rational and economic practice will be contingent on education of several factors, notably the farmer himself. Plans were proposed to assist in such studies as those of Nichols, Clyde, and Roberts.

A belated call on the Row Crop Committee found them in deep contemplation of the inevitable problems and probable changes in row-crop practice that will appear on lands where terracing, contour farming, and other conservation measures are being applied. This promises to become a major item in the agenda of the Power and Machinery engineers.

Tuesday morning's joint session of the Structures and Rural Electric Divisions took up "Water Supplies on Farms for Fire Department Use" by Harry E. Roethe of the chemical engineering Division, Bureau of Chemistry and Soil, USDA; "Farm Structures Planned for Electric Wiring and Equipment Installations" by H. B. White of Minnesota; and "New Developments in Farm Wiring" by John D. Noyes of the Detroit Edison Company, with prepared discussion by V. M. Murray of Wisconsin. Most of the material at this session was in form for publication, in contrast to the rival attraction by the machinery men, where the ASAE delegates to the International Congress of Agricultural Engineering, which met early this fall in Spain, held forth.

Of the countries visited by J. B. Davidson and G. W. McCuen (Iowa and Ohio) those seeming to be most active in agri-

cultural engineering progress were Germany and England. In the latter country a marked shortage of horses is compelling the use of mechanical power to a greater degree, or its adoption more rapidly, than might otherwise occur. A feature of English farming, not paralleled in this country, is the considerable use of gyrotillers, dolly-type machines, powered by 170-horsepower Diesel tractors—costly machines both as to investment and acre-cost due to the tremendous amount of power applied to the soil.

In Germany the outstanding type of tractor is a single-cylinder semi-Diesel of less power than even our smaller row-crop tractors, and with torque characteristics that require a spring equalizing device in the power take-off. Its use is dictated by the high cost of gasoline, burning a gas oil at one-third the gallon cost. A striking feature of the German industry is public laboratory service for all manufacturers, but especially the smaller ones. They give a great deal of attention to materials, and also to the testing of completed products, apparently under government pressure.

The rubber tire in agriculture seems to have gained even more acceptance than in this country. In England it has been applied widely to carts and wagons, etc., while in Germany it is said that 24 per cent of tractor production is fitted with rubber. Other interesting developments were producer-gas-driven trucks in France, burning wood and charcoal to escape the high cost of liquid fuels, and a new type of combine which handles the grain in a vertical position and binds the threshed straw into bundles.

Besides these and other technical matters, this session was a joint travelogue abounding in human and historical interest, interspersed with whimsies and illustrated by Prof. McCuen's movies in a fashion that would do credit to Burton Holmes.

In Tuesday afternoon's session, President W. C. MacFarlane of the Farm Equipment Institute told how that industry reacted to the depression by retrenchment elsewhere but with accelerated activity in engineering development to create new, more efficient, more economical designs to meet the stern conditions with which farming was faced. As objectives for further development he advocated the elimination of unnecessary "improvements" in the interest of price reduction, the careful adjustment of durability features to the probable useful life of the whole machine or implement, and increased emphasis on comfort and safety. He also urged more standardization, notably in wheels.

Dr. G. Bohstedt, in charge of animal nutrition research at the University of Wisconsin, discussed feed processing from that standpoint. He summarized existing data to the effect that it seldom pays to grind roughages except in cases of feed shortage where it may induce animals to eat poor substitute crops. Dairy cows should have all grains ground; as also should steers when hogs are not used for gleaning. Pigs should have small grains ground, and corn also when hard and flinty due to summer dryness, or otherwise. It seldom pays to grind for horses, and then cracking is better. Lambs, being the best natural grinders of all farm animals, almost never justify grinding. Aged animals, or others with bad mouths, may warrant grinding. He believes a modulus of three to be about right in most cases.

The paper on "Studies of Buhr Mill Design and Performance" by H. D. Bruhn, research agricultural engineer at the University of Wisconsin, revealed some striking advances in performance and durability which will appear on publication. In the ensuing discussion E. A. Silver reviewed briefly the studies at Ohio in which several departments are cooperating in the spectacular tests with "port-holed" steers. G. W. Kable of the TVA described tests and developments of very small grinders for use with small motors, say in the fractional horsepower range, with special reference to means of uniform and dependable automatic feeding. M. E. Hamilton of the J. I. Case Company gave a prepared discussion which it is hoped to publish verbatim, and T. E. Hienton of Purdue discussed the economics of grinding as affected by investment and hours of use, and by the effect of fineness on the cost of grinding and on feeding value.

Richard Boonstra, speaking from his viewpoint and experience as rural electric engineer in Northern Illinois, challenged the economic and psychological feasibility of very small electric-powered grinders, at least in areas where farmers have tractors and are accustomed to work at a tractor-power pace. He urged either the installation of larger motors or frank relinquishment of the job to internal-combustion power.

The structures engineers, meanwhile, devoted their attention to a paper "Beauty and Economy in Farm Homes" by Henry K. Holsman, Chicago architect, with prepared discussions by Mrs. Mary R. Reynolds, associate editor of "Farm Journal"; W. A. Foster, associate professor of rural architecture, University of Illinois; F. C. Lewis, associate professor in charge of farm structures at Purdue University; and Wallace Ashby, chief, division of structures, Bureau of Agricultural Engineering, USDA. During the informal discussion which followed, S. P. Lyle mentioned the government's policy of encouraging farmers to invest their improved incomes in improvements for better living, not only for a much-needed raising of rural standards, but also to reflect funds into channels useful in restoring balanced activity to the national economy. He pointed out that while 1934 was the best farm building year in a decade (with probability that this improvement would carry through next year) yet 1934 was a low year in terms of farm dwellings.

Following the Tuesday evening papers by Messrs. Huntington, Gallagher, and Parvis (for reasons of space we must now refer to the program in last month's issue for details of authors and papers to be published), Geo. W. Kable of the TVA called for data on the effect of rate reductions, as mentioned by the speakers, on revenue. Mr. Huntington cited experience that (1) rate reductions show revenue gains only when accompanied by adequate sales effort, and (2) sales effort shows a gain on any rate, indicating that sales effort and not rate is the dominating factor in sales and revenue.

Among the "nutshell reports" on late developments in rural electrification Wednesday morning, L. A. Porter, General Electric illumination engineer, called into collaboration Dr. C. C. Pink, a veterinarian who joined in describing methods and results of suitable ultraviolet radiation in the dairy barn. A gain in milk flow of 10 to 15 per cent was commonly noted, accompanied by a thriftier, healthier condition of the cows, a somewhat higher vitamin D content of the milk, and a lower bacterial content. These effects do not appear at once, but after about four to six weeks. The lower bacterial count, implying a better sanitation of the premises, calls for cooperation by the farmer. In such a case cited by Dr. Pink the count went down from a range of eight to ten thousand in the course of four weeks to about 1500. Another effect noted by Dr. Pink was a greater ability to make effective use of low-grade feeds like straw. Under radiation the cows lost their long, rough hair, became more sleek, alert, alive, much as if some of the valued concentrates like oil meal had been fed.

Another nutshell report which provoked active discussion was that on "Electric Fence" by F. C. Kingsley of Illinois Northern Utilities Co. It appears that many farmers are using it with success and enthusiasm; others have had stock killed by homemade hook-ups or by ignorant alteration of manufactured devices. Such fence seems to be fully successful with cattle and horses, also mature hogs, but sheep and small pigs sometimes get past it. Several utilities men expressed the feeling that they should not recommend anything which involved the possibility, by design or accident, of connecting 115 volts to the fence, that is, line connection. Mr. Hienton mentioned some tests at Purdue showing the effect on hogs of measured currents.

Meanwhile the machinery men were meeting jointly with the Soil and Water Conservation Division in a program practically as announced and most of which will be published in due course. A possible exception was the discussion by C. A. Logan, Soil Conservation Service, USDA, of "Sodding Equipment and Contour Furrowing." He discussed and showed slides of an experimental implement which cuts a furrow slice, lifts it out of the furrow, and transplants it alongside on a strip prepared by a shaving or scraper blade. Its effectiveness in controlling runoff in rolling pastures was illustrated and described.

The concluding sessions of the electrification men and the concurrent program of the conservation engineers on Wednesday afternoon may be passed over here in the expectation that they will be adequately covered by publication of papers. Indeed, much the same may be said of the two conservation sessions on Thursday with which the meetings concluded. Due to the absence of Mr. Bentley his paper or report was presented by Prof. Lehman of Illinois. (The morning session papers were progress reports by subcommittees of the ASAE Committee on Soil Erosion Control.) One of his major points was that the cost of terrace outlets will be excessive if they must be built to withstand any and all conditions indefinitely without intelligent watchfulness and maintenance by the farmer.

In the ensuing discussion C. D. Kinsman (USDA) and others mentioned experiments in the use of such things as road oil and sand, penetration asphalt, and gravel imbedded in asphalt—all in the search for low-cost materials which have sufficient flexibility to withstand frost heaving and thereby avoid the cost of building such massive rigid structures as would otherwise be necessary in outlets. J. W. Carpenter, Jr., in the course of his report on gully erosion control emphasized that his experience had shown that, in at least some important regions, overfall gullies could be arrested more economically by diversion of the water above the gully head than by structures in the gully.

Although it, like the others, is available for publication, popular interest impels

mention of the paper by L. C. Tschudy (USDA) on the development of small lakes for soil and water conservation with which the session and the entire meeting concluded. Besides affording reservoirs of drinking water for livestock in times of drought, such lakes have a favorable influence on the general water table, and also on ground water resources not only for farms but for towns as well. There is also a recreational value which is being borne in mind, and a contribution to the conservation of wild life.

Although a newcomer to the winter meetings, and embracing large additions of new personnel and subject matter, the Soil and Water Conservation Division took their stride like veterans, setting a pace which the older (in this connection) divisions may envy and emulate. It is precisely this completeness of manuscripts and programs which permits them to be slighted in this necessarily cursory and largely preliminary report. In terms of attendance, too, they have already established a worthy place in the winter meetings.

Pacific Coast Section Meeting

THE Pacific Coast Section of the American Society of Agricultural Engineers will hold its fourteenth yearly meeting at Davis, California, January 10 and 11. The meeting opens at noon on January 10 with a business meeting and election of officers. This will be followed by a technical session which will include papers on adobe farm buildings by J. D. Long, on small farm structures by Max E. Cook, on mechanical requirements for walnut dehydration by B. D. Moses, on mechanical beet toppers by S. W. McBirney, on rapid hay making machinery by George Glendenning, and on rural electric service of power companies by Emil J. Smith.

The annual Section dinner will be held at the California Inn on the evening of the first day with R. E. Storie, section chairman, presiding, and J. P. Fairbank acting as toastmaster. The guest of honor for the occasion will be Mr. L. F. Livingston, President of the Society, who will address the group on the subject "Modern Methods for the Modern Farm." This will be followed by an address by H. B. Walker on his impressions of the Tennessee Valley project.

The program for the forenoon of the second day will include a paper on architecture on resettlement projects by Jos. Weston, farm conservation in the Paloose Country by W. A. Rockie, and on engineering structures used in soil conservation by J. D. Bamesberger.

Immediately preceding this meeting there will be held in Davis a two-day conference on underground water and pumping for irrigation. All interested ASAE members are invited to attend this conference.

President Has Full Schedule

THE President of the American Society of Agricultural Engineers, Mr. L. F. Livingston, will travel far and do a good deal of speaking in behalf of agricultural engineering in the next few months. On January 7 he is to meet and speak to agricultural engineers from the State College of Washington and University of Idaho, and on January 8 he will address the agricultural engineers at Oregon State College. On January 10 and 11 he will attend the yearly meeting of the Pacific Coast Section of the Society, to be held at Davis, California, where he is scheduled for another address. On February 4 he will be in attendance at the Wisconsin Farmers' Week at the University of Wisconsin at Madison, where he is scheduled for an address. February 5, 6, and 7 he will attend the meeting of the Southern Section of the Society at Jackson, Mississippi, held in connection with the annual convention of the Southern Agricultural Workers Association. Also on March 6 he is scheduled for an address before the student body at Western State College at Kalamazoo, Michigan.

Washington News Letter

THE FOLLOWING news items of particular engineering interest is supplied by American Engineering Council from its headquarters in Washington:

The annual assembly of American Engineering Council will be held in Washington on January 9, 10, and 11. Preliminary to this meeting, a conference of Council's public affairs committee was held in Washington, November 1. This committee, made up of the chairmen of major subcommittees of the public affairs committee, together with representatives of national and local societies, discussed several major public policies in which engineers have an opportunity for expression of opinion.

The following subjects were included: Administration of public works; development of aeronautics; competition of government with engineers in private practice; development of water resources; the trend in patent legislation, and the demand for rural electrification. Extensive discussion was given to various phases of these topics and approval was given to the development of complete reports on these subjects at the January meeting.

In line with Council's many actions on the basic federal survey and mapping program for the United States, it was voted that Council continue to work for a coordination of basic mapping activities and that such a mapping program should not be considered an emergency or relief measure, but a fundamental matter underlying any program of national planning.

Further discussion developed around the relation of engineers to national planning. It was generally agreed that many of Council's activities were themselves examples of the basic need, in the public interest, for a broader concept of national planning; that engineers, by their training and experience, can make contributions to social and economic, as well as to technical features of planning in its national as well as its state and local phases. The public affairs committee, as a committee of the whole, considered recommendations as to how this movement may best be forwarded for presentation at the annual meeting.

The public affairs committee recorded itself as in complete sympathy with the efforts of the national Civil Service Reform League to establish a wider public understanding of the essential value of the merit system. It was recommended that the staff of Council cooperate with local and national engineering bodies to support the development and protection of the merit system as the only sound basis for improvement in the technical services of the government.

It was proposed to take steps to coordinate further the work of the national public affairs committee with the state and local public affairs committees in order that Council, in all matters, be truly representative as a complete cross section of the profession.

At the meeting of the executive committee of American Engineering Council, held November 2 in Washington, the nominating committee consisting of A. W. Berresford, chairman, H. P. Eddy, and Robert W. Yarnall, unanimously reported the selection of Dean Andrey A. Potter as nominee for the presidency of American Engineering Council for 1936-37. Dr. Potter is dean of the schools of engineering, Purdue University.

Council's membership continues to expand. When the new membership plan of nominal dues to state and local societies was adopted last January, sixteen such societies were members. Now the number is more than double, and active steps toward joining are being taken by several others.

President J. F. Coleman of Council will speak November 22 before the local section of ASCE in St. Louis. Executive Secretary Frederick M. Feiker spoke October 19 before the annual fall meeting of the Society for the Promotion of Engineering Education at Worcester, Mass. October 22 to 24, he attended a meeting of the Textile Foundation at Stockbridge, Mass. October 25, 26, and 27, he visited and talked with the members of the executive committees of the following engineering societies in New York state: Mohawk Valley Engineers Club, Utica; Technology Club of Syracuse, and the Rochester Engineers Club. On November 4, he attended an informal meeting of the secretaries of national engineering societies in New York. Recent and pending speaking engagements include the following: November 12, Board of Surveys and Maps of the federal government, and the Washington section, ASCE; November 19, Engineers Club of Philadelphia; November 20, engineering section, Association of Land-Grant Colleges, Washington. Assistant Executive Secretary L. V. Reese spoke before the Engineers Club of Baltimore, October 16, on what the coming year holds for the engineer. He also spoke November 6 before the regular luncheon meeting of the staff engineers of the Works Progress Administration in Washington.

A Diesel Short Course

ANNOUNCEMENT is made by H. E. Murdock, head of the agricultural engineering department, Montana State College, that a short-course in Diesel engines and tractors will be given at that institution January 6 to March 17, 1936. This course is intended to give training to those men who have mechanical ability and the desire to become efficient in Diesel engine and tractor operation in maintenance.

Ames Qualifies

IN ORDER to be admitted to the licensing examination and practice of profession engineering in New York state at the present time, an applicant must be a graduate of a course fully approved as an engineering curriculum. It will therefore be of interest to agricultural engineers to learn that the University of the State of New York, which, as a branch of the state education department, has supervisory powers over higher education in New York state, has notified Iowa State College that the four-year course of study leading to the degree of bachelor of science in agricultural engineering has been registered as an approved course in engineering.

Personals of ASAE Members

W. D. Ellison, hydraulic engineer, USDA Soil Conservation Service, was recently appointed superintendent of a 5000-acre project of the SCS recently established at Coshocton, Ohio, for watershed and hydraulic studies.

E. L. Kleckner has been appointed to fill the vacancy on the agricultural engineering extension staff at Purdue University, LaFayette, Indiana.

G. W. McCuen and *E. A. Silver,* agricultural engineers, Ohio Agricultural Experiment Station, are joint authors of Bulletin No. 56 just issued by that institution, entitled "Rubber-Tired Equipment for Farm Machinery."

M. W. Nixon, assistant research professor of plant pathology, New York State College of Agriculture, and rural service engineer, Empire State Gas and Electric Association, is one of the authors of Bulletin No. 636, issued July 1935 by the Cornell University Agricultural Experiment Station, entitled "Disinfesting Soils by Electric Pasteurization."

H. S. Riesbol, associate hydraulic engineer, USDA Soil Conservation Service, has recently been transferred from Guthrie, Okla., to Coshocton, Ohio, where he will have charge of run-off studies and meteorological and ground water observations on a 5,000-acre project recently established there by the SCS.

H. B. Roe and *J. H. Neal,* agricultural engineers, Minnesota Agricultural Experiment Station, are joint authors of Special Bulletin No. 170, entitled "Soil Erosion Control in Farm Operations," and Special Bulletin No. 171, entitled "Soil Erosion Control by Engineering Methods," recently issued by that station.

John B. Woods has resigned as instructor in agricultural engineering at the University of Arkansas to accept an appointment as associate engineer for the USDA Soil Conservation Service at Harrison, Arkansas.

News of the Missouri Branch

THE MISSOURI Student Branch of the American Society of Agricultural Engineers has a marked increase in enrollment this year. There are 22 students enrolled in agricultural engineering, seven of these being old members. The attendance at the meetings to date has been very satisfactory. At the first meeting there were 15 students present, at the second 30, and at the third there were 42. Most of these students, other than the ag. engineers, were from the college of agriculture, where there is an increasing interest in agricultural engineering and its possibilities.

A very interesting number of programs have been planned for the year. Several prominent men in agricultural engineering are scheduled to give talks on various occasions, and it is planned to have motion pictures at other meetings. Each senior, and any other member who wishes, is to give a technical report on some phase of agricultural engineering before the end of the year. Mr. Giles, our faculty advisor, will present a slide rule to the member giving the best report.

Early in the semester the branch left business and worries behind and went to the country for a picnic. Sides were chosen and a very close and interesting game of touch football was played. Darkness soon stopped the game, and all gathered around the fire for lunch. We found that this is one of the best ways of getting acquainted with new members.

The ag. engineers helped largely toward the success of the annual Farmers' Fair this year. The agricultural engineering department had their machinery out on the campus and the members of the branch took charge of the demonstrations. The farmers were as a whole very much interested in the machinery, and the branch members were kept busy operating the equipment and answering questions concerning it. One of the most interesting demonstrations conducted by the student branch was the operation of a one-wire electric fence for livestock.—Robert Beasley, Scribe.

Iowa State Branch News

THE IOWA STATE College Student Branch of ASAE started the new year off with a bang this fall, with the annual mixer which was held October 31 in the lounge of the Memorial Union. About 65 people were present, including 15 members of the faculty, 32 ASAE student branch members, and 10 freshmen engineers. A delicious meal was furnished by the faculty members and served by the students. A varied and interesting program with our president, Wm. McConnell, as toastmaster, gave us enjoyment for the rest of the evening. It consisted of music, dancing, a play, some very interesting feats of magic, and last, but far from least, a talk on European observations by Dr. J. B. Davidson. His talk was illustrated with many interesting pictures which he took while in Europe this fall and showed the great field which awaits development by the agricultural engineer in the future.

Our regular meetings are held jointly with a one-hour seminar class each week, and one member gives a report while another leads a discussion on the same topic. The first three meetings this fall were devoted to a study of the ASAE, its activities, its history, and its duties.

Many of the agricultural engineers attended Prof. Franklin D. Paine's talk on rural electrification which was held November 6. Prof. Paine is the rural electrification member of the Iowa extension service. His talk was concerned, in greater part, with the federal Rural Electrification Administration and its relationship to the farmer.

Plans are being laid for the first of the regular monthly meetings of the branch which it has been the policy to hold in the evening. From all indications it promises to be a very interesting one and further results will be given later.

The members are also planning to participate in the engineers' carnival and dance which is a regular feature of the engineering division here at Iowa State. We will have more about this also next month.—Geo. H. Dunkelberg, scribe.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the November issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Wm. J. Abrams, superintendent, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Mount Hope, Wis.

Donald A. Anderson, assistant technician, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 326 N. 7th St., La Crosse, Wis.

Joseph S. Buchanan, Jr., junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Project No. 2, Carton, Miss.

William Pratt Clark, assistant in engineering department, J. I. Case Co., Rockford, Ill. (Mail) 1831 Camp Ave.

Lawrence Ennis, Jr., agricultural engineering aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Greenville, Ala.

N. M. Faulk, technical foreman, Soil Conservation Service, U. S. Department of Agriculture. (Mail) SCS Camp, Linden, Tex.

Franklin D. Fulton, assistant agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) 616 St. Johns Road, Baltimore, Md.

Walter C. Hulburt, assistant in agricultural engineering (teaching and research), University of Illinois, Urbana, Ill.

Elbert E. Karns, extension agricultural engineer, University of Arkansas, Fayetteville, Ark.

Frank G. Keller, engineering aide (agricultural), Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 99, Greenville, Ala.

William L. Monts, junior technical foreman-engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 286, Newberry, S. C.

Carl T. Nordstrom, farm representative, Portland Cement Association. (Mail) 108 Victoria Place, Syracuse, N. Y.

Dr. C. C. Pink, veterinarian, 509 Main St., Oconomowoc, Wis.

Richard R. Pope, chief agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 11 Cleveland Ave., New Brunswick, N. J.

June Roberts, instructor, agricultural engineering department, Kansas State College, Manhattan, Kans.

H. E. Waldrop, project engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Reidsville, N. C.

Richard A. Wilcox, assistant technician, engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 1548 B Ave., N.E., Cedar Rapids, Iowa.

Avery W. Williamson, assistant engineering aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 155 N. Converse St., Spartanburg, S. C.

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, senior agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

AIR CONDITIONING FOR CALIFORNIA HOMES, *B. M. Woods* and *B. F. Raber*. California Sta. Bul. 589 (1935), pp. 45, figs. 12. Information is presented on air conditioning with particular reference to methods and cost.

The relative merit of different methods, applied under various conditions, is discussed. An attempt is made to supply the necessary background for understanding the types of equipment available, their principles of operation, and the degree of effectiveness to be expected under certain conditions.

A section on initial costs and estimated operating costs of various types of equipment is included as a general guide.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE OHIO STATION, *C. O. Reed, R. M. Salter, R. C. Miller, C. W. Gay, G. W. McCuen, E. A. Silver, and V. L. Overholt*. Ohio Sta. Bul. 548 (1935), pp. 89-95, figs. 2. The progress results are briefly presented of studies on fertilizer application with corn planters, trench silos, thrashing machines, wear of metals in agricultural machinery, wheel equipment for farm machinery, subirrigation, corn storage, hay chopping, and farm housing.

BARREL AND DISK SEED SCARIFIERS, *W. M. Hurst, W. R. Humphries*, and *R. McKee*. U. S. Dept. Agr. Circ. 345 (1935), pp. 24, figs. 6. Experiments are reported in which an inexpensive scarifier was devised, of barrel type, which is easy to build and suitable for farm use in scarifying small quantities of seed. River-run gravel was used as the abrasive. A farm-type concrete mixer also was used as a barrel-type scarifier, with satisfactory results.

A disk-type scarifier of larger capacity, but more costly, was designed and found to be easily operated, easily cleaned, and to cause little sprout injury. In this a stone disk was the abrasive, revolving close under a stationary disk faced with gum rubber.

Experiments were made with seed of yellow and white sweet clover, *Lespedeza sericea,* and *Crotolaria striata,* to determine the effects of these scarifiers on germination, hard seed, and sprout injury.

Best results with the barrel scarifier were obtained when the gravel was of size to pass a screen of ¾-in mesh and be retained on a screen of ½-in mesh, and when the volume of seed was one-half to two-thirds that of the gravel. The conclusion seems warranted that the best ratio of seed to gravel, by volume, is 1 to 2 to 1 to 1. The greater the ratio of seed to gravel, the longer the time required for scarification. The seed and gravel should fill the barrel not more than half, and the speed of rotation should be slightly less than will make some of the seed and gravel whirl with the barrel.

The capacity of the disk scarifier generally, but not always, increased with the speed of the disk and with the clearance between the disks. To maintain the germination percentage with increase in clearance, it was always necessary to increase the disk speed. Experiments as to deterioration of seed with age seemed to show that scarified seed do not remain viable as long as unscarified seed.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE NEBRASKA STATION. Nebraska Sta. Rpt. [1934], pp. 5, 6. The progress results are briefly presented of investigations on pneumatic tires for farm tractors, electric power for Nebraska farms, efficiency of tractor lugs, methods of cooling milk on farms, wind-driven electric plants, and pump irrigation.

MEASURING WATER FOR IRRIGATION, *J. E. Christiansen*. California Sta. Bul. 588 (1935), pp. 96, figs. 38. The chief purpose of this bulletin is to describe the more common methods and devices used for measuring irrigation water in California. Although prepared primarily for use by farmers, ditch tenders, and county agents, it includes also an explanation of some principles of water measurement and a discussion of some methods for the benefit of engineers. The more practical aspects of water measurement, together with tables for use with important devices, are presented in the first part. Explanations of theory and discussions of technical methods appear in the second part. The water measurement devices and methods dealt with include stream measurement by velocity-area methods, weirs, orifices, Parshall measuring flume, and commercial irrigation meters.

THE PHYSICAL PROPERTIES OF WEST VIRGINIA HARDWOODS, *G. P. Boomsliter*. W. Va. Engin. Expt. Sta. Res. Bul. 12 (1934), pp. 32, figs. 9. The results of tests made of the physical properties of a carload of 29 trees embracing 9 species of West Virginia hardwoods are reported and discussed.

FARM IRRIGATION PUMPING SYSTEMS, *L. J. Smith* and *H. L. Garver*. Washington Sta. Bul. 311 (1935), pp. 24, figs. 8. This bulletin, prepared in cooperation with the Washington Committee on the Relation of Electricity to Agriculture, has for its object to give farmers who desire to install their own irrigation pumping systems the necessary advice in order that they may obtain satisfactory installations at a minimum cost.

HOTBED CONSTRUCTION—ELECTRIC AND MANURE TYPES, *C. L. Vincent* and *H. L. Garver*. Wash. State. Col. Ext. Bul. 203 (1935), pp. 12, figs. 4. Practical information is given on the construction of electrically and manure heated hotbeds, together with data on costs.

RECOMMENDATIONS FOR THE CONTROL AND RECLAMATION OF GULLIES, *Q. C. Ayres*. Iowa Engin. Expt. Sta. Bul. 121 (1935), pp. 71, figs. 59. This bulletin deals with the various methods of gully control and reclamation by mechanical means. It is an attempt to capitalize the experience gained in building a large number of dams of many different types in widely distributed parts of the State of Iowa under the Federal emergency conservation program of 1933-34.

The conclusion is drawn that the control and reclamation of gullies is primarily a matter of reducing runoff and checking erosive velocities. In this work, as in other fields of endeavor, prevention is much easier and more economical and effective than corrective treatment. Wherever feasible, cutting off the flow above the heads of gullies by means of diversion ditches or terraces is the most effective single remedy that can be applied. Velocity-reducing structures in gullies may be grouped into three classes—temporary check dams, semipermanent dams, and permanent or soil-saving dams. Conditions governing choice in any given case are cost; degree of dependence to be placed on vegetative cover; willingness to provide necessary maintenance; and physical, environmental, and human factors. Brush check dams seem most effective in regions where sandy soils predominate. This is true to a lesser extent of all check dams. Brush dams should not be used in other soils unless constant care can be assured. It is essential that livestock be fenced out of gullies being controlled by check dams, and this is a desirable feature for any method of control.

TERRACING FARM LAND IN GEORGIA, *G. I. Johnson, W. N. Danner*, and *F. W. Peikert*. Ga. Agr. Col. Bul. 394, rev. (1935), pp. 24, figs. 26. This is a revision of Bulletin No. 394 of the Georgia Agricultural Extension Service and presents practical information on farm land terracing in Georgia.

SOIL EROSION BIBLIOGRAPHY, *L. H. Wieland*. U. S. Dept. Int., Soil Erosion Serv., 1935, pp. 124. This bibliography pertains in the main to (1) processes of erosional behavior under varying conditions of soil, topography, and land use, (2) geographic distribution of eroded and eroding areas, (3) methods of preventing or controlling erosion, and (4) the effect of the products of erosion on the silting of stream channels and reservoirs and the covering of lower slopes and alluvial plains.

RESULTS OF RECLAMATION INVESTIGATIONS BY THE MINNESOTA STATION. Minnesota Sta. Bul. 319 (1935), pp. 22-24, 77. Some of the principal findings of the station are briefly noted as to concrete drain tile, the effect of drainage ditches on forest growth, and the economical reclamation of stump land.

AGRICULTURAL ENGINEERING STUDIES AT THE ALABAMA STATION, *M. L. Nichols, I. F. Reed, R. D. Doner, E. G. Diseker*, and *A. Carnes*. Alabama Sta. Rpt. 1934, pp. 11, 12. The progress results are briefly presented of studies of plow action, relationship of shape of moldboard to shedding, erosion control, and effects of soil crusts on cotton stands. *(Continued on page 496)*

Agricultural Engineering Digest

(Continued from page 494)

VIBRATIONS CAUSED BY BLASTING AND THEIR EFFECT ON STRUCTURES, *E. H. Rockwell.* Wilmington, Del. Hercules Powder Co., 1934, pp. 69, pls. 2, figs. 43. Studies are reported the results of which indicate that ordinarily well-drill blasting, as usually conducted, produces motion and corresponding forces upon objects of so small a magnitude that it is practically certain no damage to buildings in the neighborhood can possibly occur, unless these buildings are within two or three hundred feet of the quarry. In cases of alleged damage resulting from blasting, particularly in localities where there are many houses in close proximity to the quarry and where claims may occur, it is desirable to secure accurate quantitative measurements of the vibrations by some kind of a recorder. If such an instrument cannot easily be obtained, it is important to employ the pin experiment which is a fairly accurate means of determining the amounts of vibration in well-drill blasting.

A large amount of related technical engineering data are presented in an appendix.

POWER ON WEST VIRGINIA FARMS, *F. D. Cornell, Jr.* West Virginia Sta. Bul. 267 (1935), pp. 44, figs. 16. The study here reported relates to the use of power on 441 West Virginia farms, on 260 of which horses furnished all of the drawbar power. Tractors were employed on 181 farms. A summary is given of the power units on both tractor and nontractor farms, which includes the number of each type of power unit, the number of farms on which each was used, and the percentage of all farms using each type of power. The average size of all farms included in the study was 254 acres.

An increasing tendency was found on the part of tractor farmers to use horses in drawbar operations. In many instances the business was not sufficiently large a unit to warrant the purchase of a tractor.

Tractors were found to have displaced 1.18 horses per farm and the use of tractors had considerable effect on the layout and size of the farm. It was found that not enough colts are being raised in West Virginia to meet the demand for power replacements.

The cost of keeping a horse on tractor farms was as great as on farms not using horses. It also was found that the development of the use of electricity and tractors has decidedly limited the use of stationary engines on farms.

ELECTRICAL POWER USAGE IN VERMONT COOPERATIVE CREAMERIES. *A. M. Camburn.* Vermont Sta. Bul. 388 (1935), pp. 8. Studies of the consumption of electricity by dairy machinery conducted in five cooperative creameries are reported. It was found that the cost of electricity amounted to 3.5 per cent of the total cost of operation, with rates ranging from 1.83 to 4.08 cents per kilowatt-hour. The kilowatt-hour usage at the several plants by 14 different types of mechanism, including lighting equipment, is presented and discussed.

A DRAWBAR DYNAMOMETER AND ITS USE IN SOIL TILLAGE EXPERIMENTS, *F. W. Giles.* Missouri Sta. Res. Bul. 226 (1935), pp. 19, figs. 14. This bulletin describes a drawbar dynamometer designed and built for use in soil tillage experiments. The dynamometer consists of three major parts, namely, (1) the hydraulic units, (2) pressure recording instrument, and (3) oil transmission line.

This dynamometer was found to be easily and quickly adapted to any farm implement. Soil resistance maps were made with the dynamometer for two ranges planted to corn for the 1934 season. It was found that for accurate maps of small areas it is necessary to secure very accurate depth measurements and correct the draft values accordingly. A common moldboard plow was found best suited to determine soil resistance, since it exerts a force over the entire cross-sectional area of the surface and the amount of cut can be kept more constant than with other types of tillage implements.

THE USE OF AN EVAPORATION INDEX IN WATERING LAWNS, *J. D. Wilson* and *F. A. Welton.* Ohio Sta. Bimo. Bul. 174 (1935), pp. 112-119, figs. 2. Lawn watering experiments are reported in which three evaporation increments were used. The results indicated that lawns require a quantity of water during the summer period which is somewhat in excess of the amount lost by evaporation from a free water surface over the same period and which will at the same time be approximately 75 per cent greater than the normal rainfall. Thus, the addition of the extra inches of water over those falling as rain [12 + (normal —actual rainfall) which will, of course, vary somewhat from year to year with the evaporation] can be efficiently regulated as to time and quantity by the use of an evaporation index corresponding to a loss of 320 cubic centimeters of water from a Livingston standardized black atmometer. The use of this index insures the application of water before growth is checked because of a soil-moisture deficiency, or about 4 or 5 days before the grass is visibly injured.

PASTURE IRRIGATION, *L. J. Smith, M. S. Grunder,* and *H. L. Garver.* Washington Sta. Bul. 313 (1935), pp. 28, figs. 10. The results of studies of pasture irrigation in western Washington conducted by the station in cooperation with the Washington Committee on the Relation of Electricity to Agriculture, the extension service of the State College of Washington, and the Western Washington Experiment Station are briefly summarized. In addition, general service information is given on water requirements of pasture, preparation of land for irrigation, sources of water, dynamiting of sloughs for the storage of water, and pasture management.

Experiments were conducted both on one-hundredth-acre plats and on pasture under actual grazing. It was found that very little labor is required with the sprinkler method of irrigation. However, a sprinkler irrigation system is more expensive to install than are other methods. The current cost for sprinkling was found to be higher per acre-inch of water delivered, but this cost was partly offset by the low labor cost and the more efficient use of water.

Data for a 5-year period, during three of which irrigation was practiced, showed that under irrigation production was maintained in pastures until late September or into October. The conclusion is drawn that lack of moisture is the factor exerting the greatest influence on the production of pasture grass during the summer and early fall months. Temperature does not appear to be a limiting factor until late in September.

Studies of the effect of irrigation and rainfall on soil moisture on three pasture plats showed that light irrigation or ordinary rains do not penetrate beyond the first foot in pasture soils, unless they occur so frequently that the upper layers become filled beyond their capacity to retain moisture. Irrigations of 3 or 4 inches reach the second foot when applied to relatively dry soil, but do not appear to affect the third foot to any extent under any of these conditions. Irrigations of from 3 to 4 inches appear to be sufficiently heavy for pasture on the Puget fine sandy loam soil if applications are made frequently enough to prevent the serious drying out of the upper layers.

A CASE OF SPONTANEOUS COMBUSTION OF HAY, *H. H. Musselman.* Michigan Sta. Quart. Bul., 17 (1935) no. 4, pp. 175-182, figs. 5. This instance is described and results of observation reported. These indicated that large masses of hay containing a certain amount of moisture favor the spontaneous generation of heat. Probably also the large mass retains the heat developed which may on this account reach the danger point. The density of the mass which is increased by chopping may also restrict the circulation of air within the mass, thus favoring the retention of heat. Ventilation flues with slatted walls to favor air movement through the mass appear to be a practical means of dissipating heat which is generated even in the normal curing of hay. As to the size of the mass or amount of moisture permissible in the hay when stored, the study gives little information. Likewise, the amount of ventilation or spacing of ventilators, if these are to be used, can only be estimated. The experience does, however, warrant a word of caution. Care should be taken in storing chopped hay to keep the moisture content to a reasonable limit, at least as low as that allowable in making a good quality of bright hay. When stored in large volume, ventilation of the mass also appears advisable.

SOIL STERILIZATION BY ELECTRIC HEAT, *I. P. Blauser.* CREA News Letter [Chicago], no. 12 (1935) pp. 4-7, figs. 7. This process as developed at the Ohio Experiment Station is described and illustrated and data from tests thereof are presented.

It was found that the resistance type of sterilizer with horizontal electrodes is easier to construct and operate than other types, but has the disadvantage of low flexibility. It was found that a sterilizer that is 10 inches deep will usually bring the soil temperature up to 210 degrees Fahrenheit in from 1 to 2 hours if the soil is moist enough to be worked easily. Data are given on the depth and area of sterilizers for different purposes.

SMALL ELECTRIC DRIERS FOR FRUITS AND VEGETABLES, *A. V. Krewatch.* CREA News letter [Chicago], no. 12 (1935), pp. 7-9, figs. 2. In a brief contribution from the Maryland Experiment Station small electric driers for fruits and vegetables developed at the station are briefly described and illustrated, and data from tests are presented.

USING POROUS HOSE IN HIGH ROW CROPS, *O. E. Robey.* Michigan Sta. Quart. Bul., 17 (1935), no. 4, pp. 225-228, figs. 3. Technical information is given. *(Continued on page 502)*

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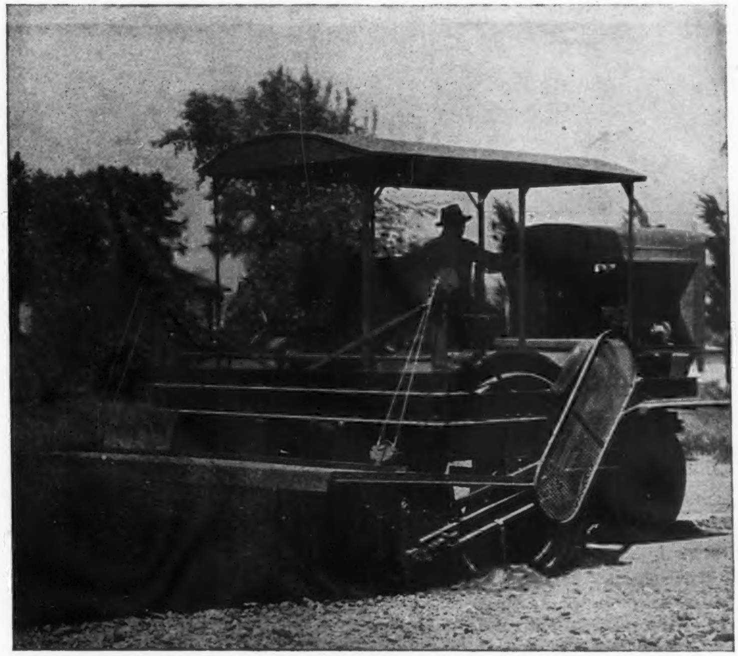

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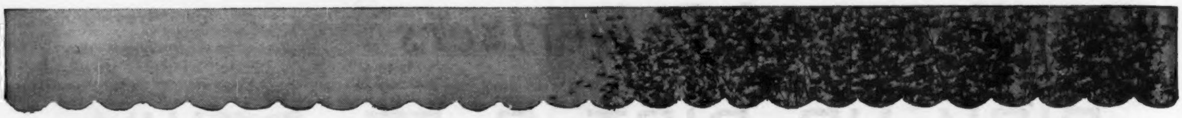

Agricultural Engineering Digest

(Continued from page 496)

RURAL COMMUNITY BUILDING PLANS, *D. G. Carter.* Arkansas Sta. Bul. 332 (1935), pp. 30, figs. 16. Typical plans developed by the station in a cooperative study with the Federal Emergency Relief Administration relating to the development of designs for community buildings are presented, together with data on costs, materials, and plan requirements.

The classification of community buildings discussed in this bulletin is (1) food processing buildings, (2) marketing structures, (3) camp and recreation buildings, (4) community meeting places, and (5) rural work centers.

The principal food-processing building is the canning center, which may be modified to include storage space, refrigeration, and slaughtering equipment. The chief demands for community marketing buildings are the enclosed retail produce market and the wholesale area market. Curb markets require special design for the few localities in the state where needed. Camp and recreation buildings include assembly halls, kitchen and dining halls, cabins, shelter houses, shelter barracks, and sanitary facilities. Number and size of structures may be modified to conform to size of the camp.

Community meeting places may be classified into four types: (1) assembly rooms, (2) auditorium, kitchen, and dining hall, (3) game or athletic courts, and (4) club houses. Usually each type may be used for more than one purpose.

Rural work centers require workrooms, storerooms, and toilet facilities, but may be elaborated to provide for shops, food processing, or specialized processing or manufacture.

The cost of the buildings, of the type shown, where built in Arkansas, will average about $1 a square foot of floor space. Saving may be effected by the use of local materials and donated labor.

CONSERVATION OF WATER BY MEANS OF STORAGE RESERVOIRS, DIVERSION DAMS, CONTOUR DIKES, AND DITCHES, *O. W. Monson.* Montana Sta. Bul. 302 (1935), pp. 48, figs. 29. Technical information is given on the design and construction of storage and diversion dams and diversion ditches and dikes for use in the development of flood irrigation; stock water reservoirs; selection of reservoir sites with reference to storage capacity, drainage area, suitability of soil, accessibility of structural materials, volume of earthwork, and natural spillway; and construction of earth dams, contour dikes, and contour ditches.

An appendix describes such structures already built.

Literature Received

RURAL ELECTRICATION, by *J. P. Schaenzer,* formerly project director, rural electrification, University of Wisconsin, The Bruce Publishing Company, Milwaukee, Wis. 59 pages, 165 illustrations, 6¼ x 9¼ inches, $1.72. A simple, concise, yet comprehensive treatment of electricity and electrical mechanism as applied to rural applications. A text particularly adapted to high school classes in vocational agriculture. The author first gives an interesting picture of electricity as a means of power, its manufacture and distribution, and its introduction as a means of service to rural districts. This is followed by a study of the installation, operation, and maintenance of electrical mechanism used on the farm and in the home. Since satisfactory results from the use of electrical equipment depend upon adequate, safe, and convenient wiring the author includes considerable information on proper materials and plans for wiring the various farm buildings. This material is supplemented by numerous illustrations. The author then discusses a large number of applications for the farm and home; the student is given an understanding of all electrical apparatus peculiar to the farm and taught how to care for it properly. Numerous tables and charts incorporate abundant factual material relative to electrical data as applied to farm life. All the material included in the text was thoroughly tried out in manuscript form by teachers of vocational agriculture in farm-mechanics classes.

ELECTRICITY IN THE HOME AND ON THE FARM, *by Forrest B. Wright,* assistant professor of agricultural engineering, New York State College of Agriculture. John Wiley & Sons, Inc., New York. 320 pages, 66 illustrations, 6x9 inches, $2.50 net. This book is the latest addition to the Wiley farm series, and is written especially for those who wish to gain a practical knowledge of electricity and its application in the home and on the farm. Although the book is designed for the needs of the school shop teacher, the subject matter is equally useful to the average householder and farmer. The author has aimed to present such fundamentals in practical jobs as will aid the student to think for himself in terms of electricity and to acquire some of the more common skills in connection with its use. The book is divided into two parts. The first part consists of a series of prac- *(Continued on page 504)*

(Continued from page 502) tical jobs arranged more or less in chronological order and including electric circuits, dry cells, door bell circuits, switches, electric fuses, condensers, and insulators, figuring wire sizes for different loads, splicing conductors, extension cords, lamp sockets, trouble lamps, watthour meters, wiring systems, insulation of houses, special circuits, transformers, electric motors, electric generators, electric heating appliances, and storage batteries. A second part consists of ten chapters of text on the fundamentals of electricity and is intended as supplementary study in connection with the jobs in the first part of the book.

PROCEEDINGS OF THE 2ND INTERNATIONAL CONGRESS OF AGRICULTURAL ENGINEERING. Commission Internationale du denie Rural, 1935. 482 pages, illustrated, 6¾ x 9¾ inches, 30 pesetas. (Orders for copies should be addressed to the secretary of the Congress, E. Aranda Heredia, Amadeo, Vives 10, Madrid, Spain.) This volume contains the complete proceedings, including technical papers, and organization of the 2nd International Congress of Rural Engineering held at Madrid, under the patronage of the Spanish government, September 26 to October 3, 1935. The technical papers presented before the Congress are arranged in four sections. Section 1 is devoted to papers on soil science, agricultural hydraulics, and rural estate management. Section 2 is devoted to farm and community building construction, including building materials. Section 3 includes the papers on agricultural machinery, and the uses of electricity in agriculture. Section 4 deals with scientific management of work in agriculture. There are, in all, 52 technical papers prepared by agricultural engineers of the United States and several European countries. These papers are published in the language in which they were originally written by the authors. The volume is profusely illustrated. American agricultural engineers who contributed papers to the Congress are I. P. Blauser, Ohio State University; J. B. Davidson, Iowa State College; Leonard J. Fletcher, Caterpillar Tractor Company; E. R. Gross, Rutgers University; G. W. McCuen, Ohio State University; E. G. McKibben, Iowa State College; H. E. Murdock, Montana Agricultural College; E. A. Silver, Ohio State University; A. A. Stone, N. Y. State Institute of Applied Agriculture; Arnold P. Yerkes, International Harvester Co. The American agricultural engineering group were represented in person at the Congress by G. W. McCuen, J. B. Davidson, and E. R. Gross.

MANUAL OF FARM SHOP WORK, by *Mack M. Jones,* associate professor of agricultural engineering, University of Missouri. The University Cooperative Store, Columbia, Missouri. 80 pages, profusely illustrated, 6x9 inches, 50 cents. This manual consists of plans for devices and appliances that may be made in the farm shop or the school shop. They have been designed and selected because of the fundamental tool processes involved, because of the usefulness or value of the jobs when done, and because of the relatively small amount of materials required. This is a revised edition of the manual used by the author in classes in farm shop work and by departments of vocational agriculture in Missouri high schools during the past several years. Although this manual may be used alone as a guide by the student while doing his shop work, it is recommended that it be supplemented by a simple job plan or work plan for each job to be done. The manual covers wood work, cold metal work, general blacksmithing, tool making and tempering, welding, soldering, and sheet metal work, harness work, and pipe fitting.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

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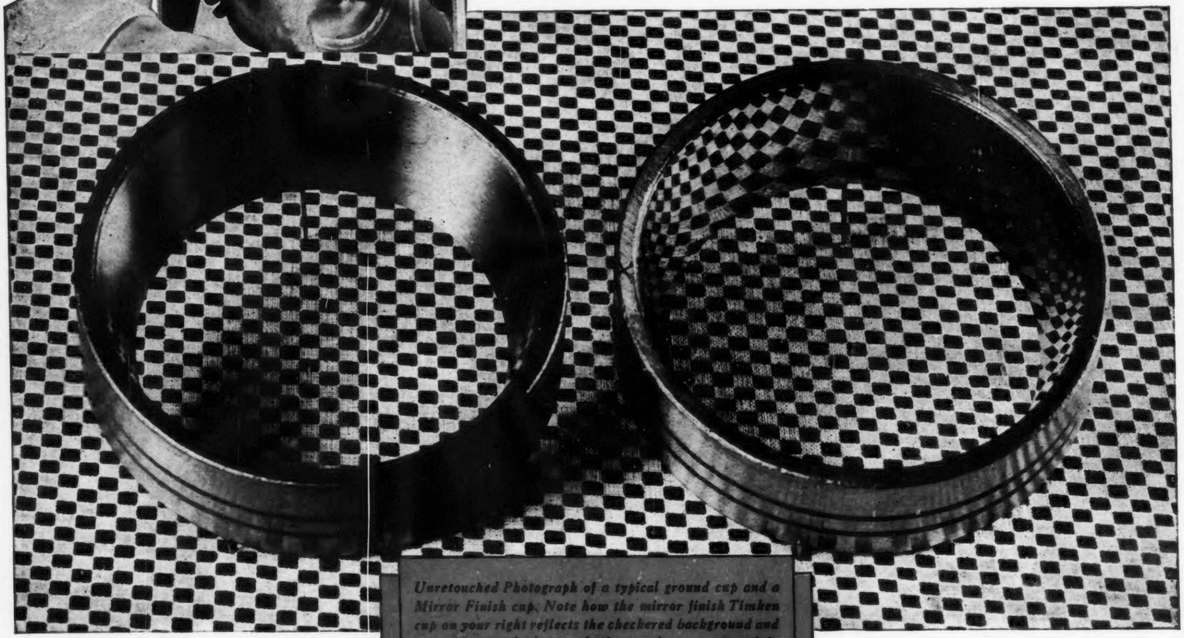

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